Natural Sciences and Engineering
Research Council of Canada

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Conseil de recherches en sciences
naturelles et en génie du Canada

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STRATEGIC GRANTS IN OCEANS

LES SUBVENTIONS THÉMATIQUES EN OCÉANS

- **Summaries of New Research Projects**
  Résumés des nouveaux projets de recherche

- **List of On-going Research Projects**
  Liste des projets de recherche en cours

- **Summaries of Completed Research Projects**
  Travaux de recherche terminés

1986-87

Canada

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FOREWORD / AVANT-PROPOS

FOREWORD

The Natural Sciences and Engineering Research Council offers a program of strategic grants to initiate or accelerate research projects in areas of Canadian interest. The aim of the program is to enable university researchers to make greater contributions than in the past towards the understanding or solution of problems of national concern, either through specific applied research projects having potential for relatively short-term benefits, or through more basic research activities designed to develop knowledge in areas of potential importance. The total budget for the strategic grants program for 1986-87 is $32 million.

In 1986-87 the strategic grants program addressed eight specific fields: 1) biotechnology, 2) communications and computers, 3) energy, 4) environmental toxicology, 5) food and agriculture, 6) industrial materials and processes, 7) oceans, and 8) open (which includes areas of national concern other than the seven identified fields).

Selection panels composed of recognized scientists and engineers from the university, industry and government sectors rate all proposals using the following criteria:

- scientific merit of the proposed research;
- excellence of the applicant(s);
- relevance of the proposed research to the field.

AVANT-PROPOS

Le Conseil de recherches en sciences naturelles et en génie offre un programme de subventions thématiques visant à lancer ou à accélérer des projets de recherche dans des domaines d'intérêt national. Le but de ces subventions est de permettre aux chercheurs universitaires de contribuer davantage à la compréhension et à la solution de problèmes d'intérêt national. Il peut s'agir de recherche appliquée pouvant s'avérer utile à court terme ou encore de recherche plus fondamentale destinée à augmenter la somme des connaissances dans des domaines d'intérêt national. Le budget total du programme en 1986-1987 est de 32 millions de dollars.

En 1986-1987, le programme de subventions thématiques comprenait huit domaines choisis:
1) l'alimentation et l'agriculture, 2) la biotechnologie, 3) l'énergie, 4) les matériaux et procédés industriels, 5) les océans, 6) le thème "ouvert" (regroupant des domaines d'intérêt national autres que les sept domaines choisis), 7) les télécommunications et l'informatique et enfin, 8) la toxicologie de l'environnement.

Des comités de sélection composés de scientifiques et d'ingénieurs reconnus provenant des secteurs universitaire, industriel et gouvernemental utilisent les critères suivants pour évaluer toutes les demandes:

- valeur scientifique de la recherche proposée;
- excellence des candidats;
- pertinence du projet par rapport au domaine désigné.

Each criterion carries equal weight. To be funded, an application must receive a high ranking under each of the three criteria. Regional considerations do not enter into the evaluation of proposals submitted under this program. The panels are responsible for deciding what is relevant to, and of priority within, the broad areas identified for support, consistent with the descriptions of the fields.

Les comités doivent accorder une importance égale à chacun des critères. Pour obtenir une subvention, le projet doit recevoir une cote élevée en fonction de chacun des trois critères. Les considérations régionales ne doivent pas entrer en ligne de compte dans l'examen des demandes. Les comités ont la responsabilité de déterminer la pertinence des divers secteurs et leur priorité à l'intérieur de chaque domaine désigné, en se basant sur les descriptions des domaines.

The strategic grants program contributes to the training of research manpower and encourages the transfer of technology to the user sector. This is the basis of its success. To facilitate this technology transfer, NSERC annually publishes booklets describing some of the research funded through the program. There is a separate booklet for each field; each one contains summaries of the new research projects funded as a result of the annual strategic grants competition, a list of all on-going projects funded by NSERC in the particular field, and summaries of strategic research projects completed in 1986, including references to publications arising from the NSERC-funded research. Further information on the research being supported by NSERC may be obtained by contacting the researcher directly, or the Strategic Grants Division at (613) 996-1597.

Le programme de subventions thématiques contribue à former des chercheurs et donne lieu à un transfert de technologie au secteur des utilisateurs: voilà la base de son succès. Afin de faciliter le transfert de technologie, le CRSNG publie, chaque année, des livrets décrivant la recherche subventionnée dans le cadre de ce programme. Chaque domaine fait l'objet d'un livret séparé; on y retrouve un résumé des nouveaux projets de recherche subventionnés suite au concours annuel de subventions thématiques, une liste de tous les projets en cours dans le domaine en question subventionnés par le CRSNG et un résumé des projets de recherche thématique terminés en 1986, y compris des références aux publications découlant de la recherche subventionnée par le CRSNG. Des renseignements supplémentaires sur les projets de recherche appuyés par le Conseil peuvent être obtenus en communiquant avec le chercheur lui-même ou avec la division des subventions thématiques au (613) 996-1597.

NSERC offers other opportunities for technology transfer under its university/industry program. Further information on this program or on any of NSERC's awards programs may be obtained by calling (613) 995-5992 or by writing:

Le CRSNG offre d'autres possibilités pour le transfert technologique grâce à son programme conjoint universités-industrie. Pour plus d'information sur ce programme ou sur les autres programmes du CRSNG, veuillez téléphoner au (613) 995-5992 ou vous adresser au:

NSERC
Communications Division
200 Kent Street
Ottawa, Ontario
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CRSNG
Division des communications
200, rue Kent
Ottawa (Ontario)
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FIELD DESCRIPTION / DESCRIPTION DU DOMAINE

OCEANS

Oceans play a key role in the Canadian life and economy. As the second largest maritime nation in the world, Canada faces many unique problems of strategic importance in areas related to resource exploration and exploitation, renewable and non-renewable resource management, environmental protection, arctic development, marine transportation, and safety of operations at sea.

High quality, mission-oriented research and development is essential to improve our capability to operate at sea, often in ice-covered water, and to protect, develop and manage the ocean environment and resources for the benefit of Canadians.

Problems related to the study of the ocean need to be solved using the physical, life, and earth sciences, as well as engineering research and development. Both fundamental and applied research proposals are eligible for support. It is important to note that proposals are judged on the three criteria for strategic grants: quality of the research, excellence of the applicant(s) and socio-economic relevance. Each criterion is weighted equally.

Innovative research applications that demonstrate strategic relevance to Oceans are encouraged. The following list indicates some of the general areas in which proposals will be considered.

-Physical Oceanography
-Chemical Oceanography
-Biological Oceanography
-Marine Geology and Geophysics
-Renewable Marine Resources
-Ocean and Coastal Engineering
-Ice in the Marine Environment
-Exploration and Exploitation of Offshore Resources
-Remote Sensing and Instrumentation
-Marine Transportation
-Environmental Monitoring
-Arctic Development
-Resource Management
-Weather, sea state and ice prediction

Because of the union of physical, biological, chemical and geological systems in the ocean, a multidisciplinary group is frequently necessary to properly address a problem.

Researchers are strongly encouraged to collaborate with an appropriate user community, and to carefully address the relevance of the research in a Canadian context.

February 1986

LES OCÉANS

Les océans jouent un rôle crucial dans la vie et dans l'économie du Canada. En tant que deuxième nation maritime au monde, le Canada doit faire face à des problèmes particuliers d'importance dans les domaines reliés à l'exploration et l'exploitation des ressources océaniques, à la gestion des ressources renouvelables et non renouvelables, à la protection de l'environnement, au développement de l'Arctique, au transport maritime, et à l'aspect sécuritaire des opérations en mer.

Il est donc essentiel qu'il s'effectue de la recherche et développement de qualité supérieure orientée vers des buts précis pour améliorer l'exploitation des étendues marines, dont une bonne partie est recouverte de glace et pour protéger, exploiter et gérer l'environnement et les ressources océaniques au profit des Canadiens.

Les problèmes à résoudre dans le domaine des océans nécessitent l'intervention de spécialistes en sciences physiques, en sciences biologiques, en sciences de la Terre, et en recherche et développement en génie. Les propositions, qu'il s'agisse de recherche fondamentale ou de recherche appliquée, sont jugées selon les trois critères des subventions thématiques: la qualité de la recherche, l'excellence du ou des candidats et la pertinence socio-économique du projet. Chaque critère est d'égale importance.

On encourage les candidats à proposer une recherche innovatrice et à démontrer sa pertinence à l'étude des océans. Voici quelques sujets généraux qui font partie du domaine:

-L'océanographie physique
-L'océanographie chimique
-L'océanographie biologique
-La géologie et la géophysique marines
-Les ressources marines renouvelables
-Le génie océanographique et des eaux côtières
-La glace en milieu océanique
-L'exploration et l'exploitation des ressources off-shore
-La télédétection et les instruments
-Le transport maritime
-L'étude de l'environnement
-Le développement de l'Arctique
-La gestion des ressources
-La météorologie, l'état de la mer et l'étude des glaces

En raison de l'interaction des systèmes physiques, biologiques, chimiques et géologiques dans les océans, il est souvent nécessaire de former une équipe multidisciplinaire pour étudier un problème de façon appropriée.

La consultation entre chercheurs et utilisateurs potentiels des résultats est fortement encouragée, et les candidats doivent discuter en détail de la pertinence de la recherche dans le contexte canadien.

février 1986

LIST OF NEW PROJECTS / LISTE DES NOUVEAUX PROJETS

Oceans / Océans

Name/Nom Department/Département University/Université	Title/titre	$*	Page
1. Biological Oceanography / Océanographie biologique			
Dodson,J.J. Biology Laval	Latitudinal patterns of life history and metabolic strategies in anadromous coregonines: genetic divergence and phenotypic plasticity * with H. Guderley, D. Pallotta (Laval)	177,313	16
Harrison,P.J. Oceanography British Columbia	Plankton productivity in the Strait of Georgia	104,900	19
2. Physical Oceanography / Océanographie physique			
a. Climate Studies - Climatologie			
Hamilton,K.P. Meteorology McGill	Tropical-midlatitude teleconnections and seasonal weather forecasting	28,500	18
Lewis,M.R. Oceanography Dalhousie	Equatorial heat and carbon fluxes	288,740	22
Lin,C.A. Meteorology McGill	The development of an ocean circulation model for coupling to the Canadian atmospheric general circulation model for climate studies * with L.A. Mysak (McGill), G.J. Boer (Can. Climate Centre)	269,000	23
b. Wave Movement - Mouvement des vagues			
Pond,G.S. Oceanography British Columbia	Numerical modeling and measurement of the circulation in B.C. fjords * with P.H. LeBlond (UBC), D. Dunbar (Seaconsult Marine Res. Ltd.), D.M. Farmer (Inst. of Ocean Sciences	234,283	24

* Total funds committed/Montant total accordé

Name/Nom Department/Département University/Université	Title/titre	$*	Page
2. Physical Oceanography / Océanographie physique			
c. Sediment Transport - Transport solides			
Greenwood,B. Geography Toronto	Nearshore sediment transport * with A.J. Bowen (Dalhousie)	296,070	17
Hay,A.E. Physics Memorial	RASTRAN: Remote acoustic sediment transport measurement * with A.J. Bowen (Dalhousie)	311,500	20
Kamphuis,J.W. Civil Engineering Queen's	Hydraulic model research on the physics of sediment transport by waves	161,680	21
3. Seabeds and Ocean Floors / Fonds marins et océaniques			
Beaumont,C. Oceanography Dalhousie	Geodynamics and thermal evolution of rifted margins and their flanks * with P. Reynolds, M. Zentilli (Dalhousie)	189,920	15
Scott,S.D. Geology Toronto	Tectonics, sulfides and robots in the Canadian Pacific * with R.L. Chase (UBC)	385,000	25

* Total funds committed/Montant total accordé

SUMMARIES OF NEW PROJECTS / RÉSUMÉS DES NOUVEAUX PROJETS

SUMMARY FOR PUBLICATION/RÉSUMÉ À PUBLIER

FIELD OF RESEARCH / DOMAINE DE RECHERCHE
(Check one/cocher la case appropriée)

☐ Biotechnology / Biotechnologie	☐ Communications and Computers / Télécommunications et informatique	☐ Energy / Énergie	☐ Environmental Topocology / Toxicologie de l'environnement
☐ Food-Agriculture / Alimentation-Agriculture	☐ Industrial Materials and Processes / Matériaux et procédés industriels	☒ Oceans / Océans	☐ Open / Ouvert

Name/Nom: Christopher Beaumont[1], Marcos Zentilli[2] and Peter Reynolds[2]

Department/Département: [1]Oceanography and [2]Geology Departments

University/Université: Dalhousie University

Phone number (optional)/N° de téléphone (facultatif): 902-424-3557

Title of Project/Titre du projet: Geodynamics and Thermal Evolution of Rifted Margins and Their Flanks.

Canada has one of the longest rifted continental margins of any country, extending from the western Arctic to the Gulf of Maine. The extensive sediments of the margin basins are a primary target for frontier petroleum exploration. Our concern is a fundamental understanding of the way these margins developed as a result of continental rifting and the divergence of lithospheric plates. We are interested in geodynamic modelling of differing rift processes to determine whether they account for variations in margin style. The implications of the results for sediment thermal histories and petroleum potential will also be assessed.

Part of the proposed work involves improving the Fission Track Dating laboratory at Dalhousie University to international standards. This is necessary in order that we can intercalibrate and assess fission track annealing in apatite and zircon with respect to argon diffusion from potassium feldspar, and aromatization/isomerization (A-I) reactions in biomarker compounds. These are all new methods for quantitatively tracing temperature histories of sediments in the 70 - 200°C range (the petroleum generation range).

Our objectives and specific proposals are as follows:

1) Intercalibrate kinetic models for geothermometers/geochronometers (thermochronometers) and A-I data in the range 70 - 200°C using well samples from thermally stable parts of the Scotia basin and Labrador margin.

2) Improve our understanding of the rift processes by developing finite element numerical models of rifting (thus building on already published work).

3) Use these dynamical models to predict the thermal histories of the margin basins and their uplifted and eroded flanks and compare the results with contemporary and ancient rifted margins.

4) Use the calibrated thermochronometers to reconstruct that part of the geological section lost by erosion on the flanks of the Nova Scotia and Labrador margins, thereby testing the dynamical model predictions.

5) Investigate the thermally anomalous parts of the rift margin basins in the regions of salt diapirs and in the deep overpressured zones, using the thermochronometers.

6) Upgrade the thermochronometry (Fission Track and $^{40}Argon/^{39}Argon$) labs at Dalhousie to international standards.

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- ☐ Biotechnology / Biotechnologie
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- ☐ Environmental Toxicology / Toxicologie de l'environnement
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- ☐ Industrial Materials and Processes / Matériaux et procédés industriels
- ☒ Oceans / Océans
- ☐ Open / Ouvert

Name/Nom: DODSON, Julian J.

Department/Département: Biology

University/Université: Laval

Phone number (optional)/N° de téléphone (facultatif):

Title of Project/Titre du projet: Latitudinal patterns of life history and metabolic strategies in anadromous coregonines: genetic divergence and phenotypic plasticity.

The proposed research program examines two major hypotheses: (1) latitudinal variation in life history traits of sympatric anadromous populations of cisco (Coregonus artedii) and lake whitefish (C. clupeaformis) in James and Hudson Bay is reflected in the genetic divergence of the populations, and thus population-specific life history traits may represent evolutionary strategies for improving reproductive fitness; (2) long term thermal compensation has led Hudson Bay cisco and lake whitefish to have a higher aerobic capacity than their counterparts in James Bay. Data concerning the genetic divergence among these populations will also indicate whether long term thermal compensation can be correlated with a genetic separation of the populations.

The analytical methods used in this research program are essentially biochemical. Determination of genetic divergence among populations involves an examination of differences in mitochondrial DNA by hydridization of the radioactively labelled, purified mitochondrial genome of lake whitefish from the St. Lawrence R. with restriction enzyme digests of partially purified mtDNA from northern populations of cisco and lake whitefish. The examination of the long term metabolic adaptation of cisco and lake whitefish populations to low temperature relies on the spectrophotometric measurement of activities of the enzymes of aerobic metabolism in red and white muscle.

Anadromous coregonines dominate the domestic fishery in James Bay and southern Hudson Bay. This program will provide knowledge of the stock structure of these species that is essential for the development of a management policy that must guarantee levels of harvest in the face of increasing fishing pressure and environmental modification. This program will also provide knowledge of the metabolic capacity of both species that will contribute to assessing the environmental impact of hydroelectric dams.

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SUMMARY FOR PUBLICATION/RÉSUMÉ À PUBLIER

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☐ Biotechnology / Biotechnologie	☐ Communications and Computers / Télécommunications et informatique	☐ Energy / Énergie	☐ Environmental Toxicology Toxicologie de l'environnement
☐ Food-Agriculture / Alimentation-Agriculture	☐ Industrial Materials and Processes / Matériaux et procédés industriels	☒ Oceans / Océans	☐ Open / Ouvert

Name/Nom: BRIAN GREENWOOD

Department/Département: GEOGRAPHY/GEOLOGY

University/Université: TORONTO

Phone number (optional)/N° de téléphone (facultatif): (416) 284-3301

Title of Project/Titre du projet: NEARSHORE SEDIMENT TRANSPORT

Recent completion of research by the Canadian Coastal Sediment Study (C^2S^2) under the auspices of the National Research Council's Associate Committee for Research on Shoreline Erosion and Sedimentation (ACROSES) revealed a need for better understanding of the basic physics of sediment transport in the nearshore before accurate predictors of value to the engineering community could be derived. Furthermore, an overall judgement was the value of more and better field measurements of nearshore processes. To this end, cooperative research between Dalhousie and Toronto is aimed at designing and executing prototype experiments in a range of coastal environments (non-tidal, tidal, barred, non-barred, and of varying slopes, grain size and energy levels) in order to:
(i) use, and further develop where necessary, new instruments for monitoring sediment transport (optical backscatter sensor, acoustic suspended sediment profiler) and the dynamics of the bottom boundary (high resolution remote tracking sonar, jauge nucleaire);
(ii) determine the vertical and horizontal structure of the nearshore velocity field and its temporal variation with the primary forcing function (local wave field);
(iii) relate the local velocity field to bottom boundary roughness (especially bedforms) and investigate the wave-current flow regime sequence;
(iv) define appropriate friction factors for transport models in the nearshore;
(v) test simple, physically-based models for sediment transport and provide a first qualitative description of a total beach response model;
(vi) test the value of existing transport predictors (engineering type) and their basic assumptions so giving guidance to future developments.

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- ☐ Biotechnology / Biotechnologie
- ☐ Communications and Computers / Télécommunications et informatique
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- ☐ Industrial Materials and Processes / Matériaux et procédés industriels
- ☒ Oceans / Océans
- ☐ Open / Ouvert

Name/Nom: Kevin Hamilton

Department/Département: Meteorology

University/Université: McGill

Phone number (optional)/N° de téléphone (facultatif):

Title of Project/Titre du projet: Tropical-midlatitude Teleconnections and Midlatitude Weather Forecasting

The North American weather on monthly and seasonal timescales is known to be influenced by oceanic and atmospheric conditions in the tropical Pacific. The most dramatic instances of this effect have occurred during major tropical El Nino events (as in 1982/83) when very unusual weather patterns have often been experienced in North America. The existence of a significant tropical-midlatitude weather connection has been confirmed by many observational and modelling studies. However, there remains much to be learned about dependence of the extratropical atmospheric circulation on the detailed geographical patterns of tropical oceanic and atmospheric anomalies. At present there are a number of modelling studies being conducted to elucidate this issue (including some at the Canadian Climate Centre of the Atmospheric Environment Service). The present proposal is for a very detailed empirical study of the tropical-midlatitude weather connections using historical data concerning sea surface temperature, rainfall, atmospheric pressure and temperature for the period 1875-present. The results will be of value for comparison with the model studies that are underway. It is also anticipated that the proposed study will uncover empirical relationships between tropical and midlatitude conditions that can be used directly as an aid to monthly and seasonal forecasting in North America, particularly for the monthly forecasts now being routinely issued to the public by the Canadian Climate Centre.

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- ☐ Industrial Materials and Processes / Matériaux et procédés industriels
- ☒ Oceans / Océans
- ☐ Open / Ouvert

Name/Nom: PAUL J. HARRISON

Department/Département: OCEANOGRAPHY

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Phone number (optional)/N° de téléphone (facultatif): (604) 228-4198

Title of Project/Titre du projet: Plankton Productivity in the Strait of Georgia.

Three major areas of the Strait of Georgia have been identified as important sites of nutrient input into the surface, sun-lit zone where phytoplankton (microscopic algae) grow. Nitrogen is the nutrient which limits primary productivity in the spring and summer in the strait, but the nitrogen dynamics of these areas has not been thoroughly investigated. Light may also limit primary productivity in areas of active mixing or during the fall and winter. Further understanding in these areas is required and this can be accomplished through a combination of field and laboratory studies.

Two of the three major areas which affect nutrient input into the strait (the north end of the strait at Discovery Passage and the Fraser River plume) will be studied during three intensive cruises. Physical, chemical and biological parameters will be measured in order to describe spatial and temporal distributions of primary productivity over a two-week, spring-neap tidal cycle. Bacterial biomass and growth will be assessed and nitrogen uptake experiments will be conducted to determine how bacteria compete with phytoplankton for nitrogen. Zooplankton vertical hauls will be made to determine biomass and species composition and to assess if these areas have high food potential for fish. Since the surface current patterns in these areas are complex and variable, a tidal model and daily picture of surface temperature obtained by a remote sensing satellite facility will be used to assist in data interpretation.

Laboratory experiments will be conducted on a red tide dinoflagellate and possibly other dominant phytoplankers from these areas to gain a basic understanding of how fluctuations in the two key environmental factors, light and nutrients (nitrate and ammonium) might affect growth and primary productivity.

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SUMMARY FOR PUBLICATION/RÉSUMÉ À PUBLIER

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- ☐ Biotechnology / Biotechnologie
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- ☒ Oceans / Océans
- ☐ Open / Ouvert

Name/Nom: A.E. HAY/A.J. BOWEN

Department/Département: PHYSICS/OCEANOGRAPHY

University/Université: MEMORIAL/DALHOUSIE

Phone number (optional)/N° de téléphone (facultatif):

Title of Project/Titre du projet: RASTRAN: Remote Acoustic Sediment Transport Measurement

This proposal is based on several key ideas. One is that remote acoustic detection techniques represent a very promising approach to the study of sediment transport in the oceanic bottom boundary layer. In addition, the general problem of sediment transport is one about which much remains to be understood, and one which is in need of innovative experimental approaches. Finally, there are basic scientific and technical questions which must be addressed before a suitable acoustic system can be produced as a marketable product. We therefore propose to develop a bottom-mounted apparatus for suspended sediment transport research.

Our objectives are to develop a dual frequency prototype capable of measuring suspended sediment size, concentration and (ultimately) velocity, and to develop the calibration techniques and data processing algorithms necessary for this purpose. Our approach is to define the system requirements by combining our current levels of understanding of the acoustic scattering problem and sediment transport mechanisms. The system will be constructed as separate and independently testable modules using available components as much as possible. Evaluation and assessment will occur on an ongoing basis through a series of laboratory tests and field experiments. The significance of the project is that the system will have a unique capability for sediment transport research and monitoring, an area of great practical importance to both coastal and offshore development. Both the system and the results will therefore be of considerable interest to the commercial and research sectors.

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Department/Département: Civil Engineering

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Title of Project/Titre du projet: Hydraulic Model Research on the Physics of Sediment Transport by Waves

The advance of knowledge in coastal engineering is faced with a distinct barrier at the present time: the lack of understanding of the more basic physical principles of sediment transport. Results based on field experiments have been difficult and expensive to obtain in the past and have been haphazard. The field input parameters also cannot be chosen at will. Many of the interactions can be studied in the laboratory however, and the present study investigates these principles systematically using hydraulic models. Our laboratory has concentrated on developing these modelling techniques with respect to coastal sediment transport since 1970 and hence is properly equipped and has the experience to do this work.

The investigation will first focus on bulk bedload and suspended load sediment transport rates along a straight beach. Next it will assess the effect of regular vs irregular model waves to establish a firm connection between earlier model tests and prototype. This will be followed by a determination of the effect of angle of wave approach. Then velocity and sediment distributions will be determined both in the offshore as well as the vertical direction and finally the experiments will be set into an extended theoretical-empirical framework in order to be immediately useful to the profession.

There are many immediate applications of this research such as improved design of fishing ports, commercial shipping channels and ports, recreational facilities (beaches, marinas). It will also enhance our understanding of non-standard coastal situations (eg. Cohesive bluff shorelines and Beaufort Sea Shores) and of property losses and shore damage (eg. Great Lakes, Beaufort Sea).

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☐ Industrial Materials and Processes / Matériaux et procédés industriels
☒ Oceans / Océans
☐ Open / Ouvert

Name/Nom: Marlon Ray Lewis

Department/Département: Oceanography

University/Université: Dalhousie

Phone number (optional)/N° de téléphone (facultatif): 902-424-3513

Title of Project/Titre du projet: Equatorial Heat and Carbon Fluxes

Fluctuations in climate on scales of months to years involve global, not local, atmospheric and oceanic processes. In particular, oceanic processes occurring at low latitudes have an influence on the global atmosphere out of proportion to their geographical percentage of the earth's surface. Here, I propose to examine:

1.) aspects of the equatorial heat budget affecting tropical sea-surface temperature. Variations in tropical sea surface temperature have large effects on climate fluctuations at scales of months to several years. Specifically I propose to compare the relative fluxes of energy out of the base of the equatorial mixed layer due to a.) turbulent fluid motions and b.) penetration of visible irradiance. The latter will be a function of the concentration of pigments associated with phytoplankton; physical processes that affect the growth of phytoplankton will in turn affect the heat budget of the mixed layer by altering the quantity of energy lost by transmittance out of the base.

2.) aspects of the equatorial carbon budget which affect atmospheric carbon dioxide concentration. Observed secular trends in atmospheric carbon dioxide lead to an expectation of a 1.5-4.5 C increase in temperature over the next century. The ocean, through the uptake of inorganic carbon by phytoplankton and their subsequent loss by sinking, is the primary sink for atmospheric carbon dioxide. The rate of 'new' photosynthetic production available for such export, which is currently uncertain to within an order of magnitude, and its relation to physical processes which supply nutrients, will be examined in the highly productive, but variable, equatorial ocean.

SUMMARY FOR PUBLICATION/RÉSUMÉ À PUBLIER

FIELD OF RESEARCH / DOMAINE DE RECHERCHE
(Check one/cocher la case appropriée)

- ☐ Biotechnology / Biotechnologie
- ☐ Communications and Computers / Telecommunications et informatique
- ☐ Energy / Énergie
- ☐ Environmental Toxicology / Toxicologie de l'environnement
- ☐ Food-Agriculture / Alimentation-Agriculture
- ☐ Industrial Materials and Processes / Matériaux et procédés industriels
- ☒ Oceans / Océans
- ☐ Open / Ouvert

Name/Nom: Charles A. Lin

Department/Département: Meteorology

University/Université: McGill University

Phone number (optional)/N° de téléphone (facultatif):

Title of Project/Titre du projet: The Development of an Ocean Circulation Model for Coupling to the Canadian Atmospheric General Circulation Model for Climate Studies

The purpose of this research is to develop and implement an upper ocean model for coupling to the Canadian atmospheric general circulation model. The latter model is located in the Canadian Climate Centre of the Atmospheric Environment Service, Environment Canada. A coupled ocean-atmosphere model is essential for climate simulations on timescales of a season and longer.

The specific objectives are: 1) To understand the mixing processes in ocean circulation. This is accomplished by formulating a basin scale ocean model with idealized geometry, and with idealized atmospheric forcing at the air-sea interface. 2) To use the results of 1) to develop a global upper ocean model with proper mixing processes and predicted horizontal motion. 3) To couple the upper ocean mocel to the Canadian atmospheric model for climate simulations of a season and longer. Multi-year simulations of the coupled ocean-atmosphere model with the current CO_2 concentration will be made, in order to better understand the nature of interannual variability of the atmosphere, and to prepare for impact studies of an increased CO_2 concentration.

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SUMMARY FOR PUBLICATION/RÉSUMÉ À PUBLIER

FIELD OF RESEARCH / DOMAINE DE RECHERCHE
(Check one/cocher la case appropriée)

☐ Biotechnology / Biotechnologie	☐ Communications and Computers / Télécommunications et informatique	☐ Energy / Énergie	☐ Environmental Toxicology Toxicologie de l'environnement
☐ Food-Agriculture / Alimentation-Agriculture	☐ Industrial Materials and Processes / Matériaux et procédés industriels	XX Oceans / Océans	☐ Open / Ouvert

Name/Nom: S. Pond

Department/Département: Oceanography

University/Université: University of British Columbia

Phone number (optional)/N° de téléphone (facultatif): (604) 228-2205

Title of Project/Titre du projet:

Numerical modeling and measurement of the circulation in B.C. fjords.

The goals of this project are:

1) To extend an existing two dimensional numerical model of Burrard Inlet (Vancouver Harbour) - Indian Arm to include wind and fresh water run-off effects as well as tidal forcing and to test and modify the model as necessary using the extensive recent data sets which have observations of the currents as well as temperature and salinity observations:

2) To adapt the model to simulate Knight Inlet which is a larger system with stronger wind and fresh water input effects.

3) To collect additional field data using the model results as a guide to critically test the models. In particular to obtain current observations in the upper 15 m since there are almost none at present.

Our long term goal is to develop a computer model which, when fed the appropriate environmental factors, predicts reliably the medium to long term evolution of a coastal inlet's circulation and water properties. Such predictive ability would help us in making management decisions about the use of our coastal inlets: where to permit discharge of materials and where to avoid it, where to site mariculture projects, etc. The development of predictive models should increase our understanding of inlet (fjord) dynamics - how the motions produced by tides, winds and fresh water input interact to produce the resultant flow and water property distributions.

SUMMARY FOR PUBLICATION/RÉSUMÉ À PUBLIER

FIELD OF RESEARCH / DOMAINE DE RECHERCHE
(Check one/cocher la case appropriée)

☐ Biotechnology / Biotechnologie	☐ Communications and Computers / Télécommunications et informatique	☐ Energy / Énergie	☐ Environmental Toxicology Toxicologie de l'environnement
☐ Food-Agriculture / Alimentation-Agriculture	☐ Industrial Materials and Processes / Matériaux et procédés industriels	☒ Oceans / Océans	☐ Open / Ouvert

Name/Nom: STEVEN D. SCOTT

Department/Département: Geology

University/Université: Toronto

Phone number (optional)/N° de téléphone (facultatif): (416) 978-5424

Title of Project/Titre du projet: TECTONICS, SULFIDES AND ROBOTS IN THE CANADIAN PACIFIC

We are in a new age of oceanographic research in which regional surveys of the past are suggesting theories and models that require careful testing and an age of robots instead of manned submersibles for conducting deep-ocean research. Thanks to a previous NSERC Strategic grant, R.L. Chase of the University of British Columbia and I have been leaders in the discovery and study of hotsprings that are producing sulfide deposits of copper, zinc, silver and gold on the deep ocean floor, and in the application of this knowledge to ancient ores that are now on land. Our observations have prompted us to ask specific questions relating tectonic and volcanic processes to sulfide mineralization on oceanic spreading ridges. The northern Juan de Fuca and Explorer Ridges in Canadian Northeastern Pacific waters represent a microcosm of ridge processes and types of deposits unparalleled in the world and all within one or two days steaming time from Canadian ports. The very large metallic sulfide deposits on Explorer Ridge, which we were the first to discover in 1984, are a superb natural laboratory for studying ore-forming processes and may someday be of economic importance to Canada. Our project will contribute to the development of a new Canadian robotic Remote Operated Vehicle (ROV) which will be used to explore these and other deep-ocean sites in place of manned submersibles. Canada has a shortage of the highly skilled manpower needed for oceanographic research. Our program has 30 man-years of such training.

LIST OF ON-GOING RESEARCH PROJECTS / LISTE DES PROJETS DE RECHERCHE EN COURS

Name/Nom Department/Département University/Université	Title/titre	$*
3. Physical Oceanography / Océanographie physique		
LeBlond,P.H. Oceanography British Columbia	Wave generation in the marginal ice zone	47,300
4. Offshore Structures / Installations pétrolières au large des côtes		
Davenport,A.G. Engineering Western Ontario	Wind and wave loads on offshore structures * with B.J. Vickery, M. Novak, D. Surry, N. Isyumov (UWO)	151,500
Isaacson,M. Civil Engineering British Columbia	Loading and response of offshore structures due to waves and currents	184,500
5. Remote sensing / Télédétection		
Austin,G.L. Physics McGill	Development of real time processing strategies for marine radars	169,500
LeBlond,P.H. Oceanography British Columbia	Northeast Pacific Circulation Study (NEPCS) * with G.S. Pond (UBC), L.A. Mysak (McGill), R.E. Thompson, T.C. Royer, (Alaska)	246,680
Jernigan,E. System Design Eng. Waterloo	Image analysis of sea ice and ocean radar data * with J.F. Sykes, E.R. LeDrew, P.J. Howarth (Waterloo)	253,329
Walsh,J. Eng. & Applied Sc. Memorial	Research on groundwave radars for ocean wave measurement * with W. Perrie (Bedord Inst.) S.P. Singh, W.D. Winsor (Memorial)	344,000
Wells,D.E. Surveying Eng. New Brunswick	Marine Geodesy applications * with P. Vanicek, R.B. Langley (UNB)	277,500

* Total funds committed/Montant total accordé

Oceans / Océans

Name/Nom Department/Département University/Université	Title/titre	$*
1. Biological Oceanography / Océanographie biologique		
Fletcher,G.L. Marine Sciences Memorial	Improved freezing resistance of Atlantic salmon by antifreeze gene transfer * with C.L. Hew (Toronto), P.L. Davies (Queen's)	199,300
Hsieh,W.W. Oceanography British Columbia	Interannual variability in the northeast Pacific Ocean and its influence on Sockeye salmon migration routes * with K. Hamilton, L.A. Mysak (McGill), C. Groot (Pac. Bio. Station BC)	326,500
Ingram,R.G. Oceanography McGill	Hydrodynamic control of micro-algae and particulate matter under sea ice * with L. Legendre (Laval), J.C. Therriault, S. Demers (Fish. Ocean. Can), B.F. D'Anglegan (McGill)	388,380
Leggett,W.C. Biology McGill	Regulation of metamorphosis in marine fish and its effect on recruitment	193,530
2. Marine Pollution / Pollution Marine		
Desnoyers,J.E. INRS-Océanolog. Québec - INRS	Formation d'émulsions et dispersion des huiles dans l'eau de mer * avec E. Pelletier (INRS)	207,000
MacKay,D. Env. Studies Toronto	A study of hydrocarbon partitioning in the marine environment	118,500

* Total funds committed/Montant total accordé

Name/Nom Department/Département University/Université	Title/titre	$*
6. Seabeds and Ocean Floors / Fonds marins et océaniques		
Edwards,R.N. Physics Toronto	The development of sea floor electromagnetic mapping methods	94,500
Ladanyi,B. Civil Engineering École Poly.	Cone penetration testing of offshore permafrost	256,600
Louden,K.E. Oceanography Dalhousie	Arctic heat flow * with A. Judge (Dept. Energy, Mines & Res.)	241,500
Scott,D.B. Marine Geology Dalhousie	Quaternary studies of N. Atlantic ODP sites * with L. Mayer, F.S. Medioli (Dalhousie), P.J. Mudie (Bedford Inst.)	241,000
7. Sea Ice / Glace de mer		
Gates,E.M. Mechanical Eng. Alberta	Marine icing * with E.P. Lozowski (Alberta)	256,500

* Total funds committed/Montant total accordé

LIST OF COMPLETED RESEARCH PROJECTS /
LISTE DES PROJETS DE RECHERCHE TERMINÉS

Oceans / Océans

Name/Nom Department/Département University/Université	Title/titre	$*	Page
1. Biological Oceanography / Océanographie biologique			
Knoechel,R. Biology Memorial	Plankton rate processes in oligotrophic and coastal oceans	84,804	47
Mackie,G.O. Biology Victoria	Impact of "jellyfish" predation upon fish larvae	74,440	48
Scheibling,R.E. Biology Dalhousie	Sea urchin disease: ecologic and economic implications * with K.H. Mann (Dalhousie)	219,570	56
2. Marine Pollution / Pollution Marine			
Sanderson,B.G. Physics Memorial	Studies of wave induced diffusion * with P.H. LeBlond (UBC)	13,000	55
Sprague,J.B. Zoology Guelph	Flux of cadmium through an arctic marine ecosystem	81,141	58
3. Ocean Engineering / Génie océanique			
Kamphuis,J.W. Civil Engineering Queen's	Research on the hydraulic modelling of artificial sand islands * with A. Brebner (Queen's)	145,500	46
4. Physical Oceanography / Océanographie physique			
Huntley,D.A. Oceanography Dalhousie	The movement of water and sediment near the sea bed * with A.J. Bowen (Dalhousie)	112,006	45
Miller,J.R. Physics York	Investigation of water colour interpretation algorithms for case 2 waters	99,200	50
Pond,G.S. Oceanography British Columbia	Horizontal structure and dynamics of low frequency velocity and density variations in the Strait of Georgia * with P.H. LeBlond (UBC)	142,710	52

* Total funds awarded/Montant total accordé

Name/Nom Department/Département University/Université	Title/titre	$*	Page
4. Physical Oceanography / Océanographie physique			
Ruddick,B.R. Oceanography Dalhousie	Salt finger and diffusive fluxes at low stability ratio	55,456	53
Wangersky,P.J. Oceanography Dalhousie	The sources, nature, and size distribution of particles in the ocean	314,044	59
5. Seabeds and Ocean Floors / Fonds marins et océaniques			
Beaumont,C. Oceanography Dalhousie	The development and thermal histories of continental margin sedimentary basins * with C. Keen (Atlantic Geoscience Centre)	207,740	41
Boyd,R. Geology Dalhousie	Models for coastal and continental shelf sedimentation from sable island bank * with C.L. Amos (Atl. Geosc. Centre), A. Ruffman (Geomarine Ass. Ltd.)	99,600	42
Hall,J.M. Ctre Marine Geol. Dalhousie	A comparison of the effect on physical properties of short duration and prolonged sea water drawdown on Troodos type oceanic crust	65,182	43
Muehlenbachs,K. Geology Alberta	An integrated study of precious and base metal mobilization in hydro-thermally altered oceanic crust * with B.E. Nesbitt (Alberta)	179,832	51
Ryall,P.J.C. Geology Dalhousie	Investigations of mid-ocean ridges and polymetallic sulphide deposits using an electric rock-core drill * with J.M. Hall, M. Zentilli (Dalhousie), J.M. Franklin (EMR)	219,500	54
Scott,S.D. Geology Toronto	Young seamounts of the northeast Pacific Ocean * with R.L. Chase (UBC), T.J. Barrett (Toronto)	396,022	57

* Total funds awarded/Montant total accordé

Name/Nom Department/Département University/Université	Title/titre	$*	Page
6. Sea Ice / Glace de mer			
Haykin,S. Communications Res. Lab. McMaster	Ice surveillance in the Arctic using surface-based radar	205,050	44
Michel,B. Génie civil Laval	Impact de la glace sur les ouvrages de génie civil de l'Arctique, à parois inclinées	403,700	49

* Total funds awarded/Montant total accordé

SUMMARIES OF COMPLETED RESEARCH PROJECTS / TRAVAUX DE RECHERCHE TERMINÉS

Name/Nom: C. Beaumont and C.E. Keen*
Department/Département: Oceanography Department,
University/Université: Dalhousie University
Phone number(Optional)/N° de téléphone (facultatif): 902-424-3557
Title of Project/Titre du projet:

The Development and Thermal Histories of Continental Margin Sedimentary Basins

*Atlantic Geoscience Centre, Bedford Institute of Oceanography, Dartmouth, Nova Scotia

Canada has one of the longest rifted continental margins of any country, extending from the western Arctic to the Gulf of Maine. The extensive sediments of the margin basins are a primary target for frontier petroleum exploration. Our concern is a fundamental understanding of the way these margins developed as a result of continental rifting and the divergence of lithospheric plates. We are interested in geodynamic modelling of different rift processes to determine whether they account for variations in margin style. The implications of the results for sediment thermal histories and petroleum potential was also assessed.

The present study concentrated on thermo-mechanical model simulations of syn- and post-rift evolution of specific continental margins. The concepts used in the model include stretching of the crust and mantle parts of the lithosphere by two factors $\beta(x)$ and $\delta(x)$. These two factors vary with position across the rift zone and nascent margin and can, in principle, be determined from seismic measurements across the margin. The stretching factors control the thermal and subsidence history of the resultant rifted margin and together with a sediment budget allow the depositional and thermal history of the margin to be tracked.

Specific margins that have been modelled include: Labrador, the Scotian Basin, the LaHave Platform and the Baltimore Canyon and Carolina Troughs, all of the east coast margin of North America.

The model temperature histories were used to predict levels of organic thermal maturation in the sediments of the modelled cross sections and the predictions were compared with measured temperatures, vitrinite reflectance and aromatization and isomerization reactions in biomarker compounds.

The thermo-mechanical model was also used to investigate the response of a rifted continental margin to overthrusting to produce a collisional orogen (mountain range).

Other work included the development of a dynamical finite element model of lithospheric extension and rifting. This model examines the way in which the lithosphere extends when it is heated, is uplifted or is subject to horizontal extensional forces. The model allows for variations in composition, temperature and rheology within the deforming lithosphere. The results of simple models indicate that uplift of rift shoulders and concomitant subsidence of the rift zone during extension are related to the distribution of stretching and to the flexural strength of the lithosphere.

Publications

Braun, J. and Beaumont, C., in press. Styles of continental rifting: results from dynamical models of lithospheric extension. Canadian Society of Petroleum Geologists, Memoir 12, eds: C. Beaumont and A. Tankard.

Issler, D.R., and Beaumont, C., in press. Estimates of terrestrial heat flow in offshore eastern Canada: Discussion, Can. J. Earth Sciences.

Stockmal, G., and Beaumont, C., in press. Geodynamic models of convergent margin tectonics: the southern Canadian Cordillera and the Swiss Alps, Canadian Society of Petroleum Geologists, Memoir 12, eds: C. Beaumont and A. Tankard.

Keen, C.E., and Beaumont, C., in press. Geodynamics of continental margins. Volume EG-1 of Decade of North American Geology, ed. M.J. Keen and G.L. Williams.

Issler, D.R., and Beaumont, C., in press. A finite element model of the subsidence and thermal evolution of extensional basins: application to the Labrador continental margins. Soc. Econ. Paleon. and Min. Spec. Publ. (Accepted October 1985).

Stockmal, G., Beaumont, C., and Boutilier, R., 1986. Geodynamic models of convergent margin tectonics: the transition from rifted margin to overthrust belt, Am. Assoc. Petrol. Geol. Bull., 70, 181-190.

Mackenzie, A.S., Beaumont, C., Boutilier, R., and Rullkotter, J., 1985. The aromatization and isomerization of hydrocarbons and the thermal and subsidence history of the Nova Scotian margin, Phil Trans. Roy. Soc. Lond. A, 315, 203-232.

Beaumont, C., Boutilier, R., Mackenzie, A.S., and Rullkotter, J., 1985. Isomerization and aromatization of hydrocarbons and the paleothermometry and burial history of the Alberta foreland basin, Am. Assoc. Petrol. Geol. Bull., 69, 546-566.

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SUMMARY FOR PUBLICATION/RÉSUMÉ À PUBLIER

FIELD OF RESEARCH / DOMAINE DE RECHERCHE
(Check one/cocher la case appropriée)

- ☐ Biotechnology / Biotechnologie
- ☐ Communications and Computers / Télécommunications et informatique
- ☐ Energy / Energie
- ☐ Environmental Toxicology / Toxicologie de l'environnement
- ☐ Food-Agriculture / Alimentation-Agriculture
- ☐ Industrial Materials and Processes / Matériaux et procédés industriels
- ☒ Oceans / Oceans
- ☐ Open / Ouvert

Name/Nom: Dr. Ron Boyd

Department/Département: Geology

University/Université: Dalhousie

Phone number (optional)/N° de téléphone (facultatif): (902) 424-2363

Title of Project/Titre du projet: Models for Coastal and Continental Shelf Sedimentation from Sable Island Bank.

The Sable Island Bank region of the Scotian Shelf has been a site of several large offshore gas discoveries in the last decade. The research in our project has been directed to understanding the surficial sediments and stratigraphy on the Bank. This information is critical to engineers who need to build production platforms, pipelines and further exploration sites on the surficial sediments. We have found a complex history under Sable Island Bank which is primarily the result of glaciation during the last 2-3 million years. The bank is everywhere underlain by Tertiary sediments older than 2 million years. These have been incised by valley systems 100-500m deep which were carved by water melting under the base of a thick continental ice cap. Smaller glaciations since that time have infilled the channels to the north of Sable Island with glacial sediments. Further south deep glacial channels are less common and the sedimentation history records a series of at least 3 sea level falls and subsequent rises. Each sea level fall saw river channels cut into the underlying sediments and each rise generated a widespread transgressive unconformity. The three unconformities can be traced over most of Sable Island Bank except the region between the submarine canyon of the Gully and Sable Island itself. At the southern end of the river systems each sea level lowstand deposited a shelf edge delta 10-50m thick. This model establishes a framework to identify the sediments found on Sable Island Bank and a method to predict the properties of the sediments and base engineering decisions regarding offshore construction.

Name/Nom: HALL, J.M.
Department/Département: Geology
University/Université: Dalhousie
Phone number(Optional)/N° de téléphone (facultatif): 902-424-6510
Title of Project/Titre du projet: Investigation of the significance of major crush zones in the circulation of sea water in newly formed oceanic crust.

This project has contributed significantly to knowledge of ocean crust through studies of aspects of Troodos type oceanic crust that are probably closely analogous to properties of in-situ oceanic crust. In particular, it has been demonstrated:

(i) that in an area of prolonged cold sea water drawdown, intense low temperature alteration extends to 250 m depth in the crust, below which a 300 m thick little altered zone of strongly magnetized extrusives is followed at depth by a sharp rise in dike density and high temperature hydrothermal alteration. NRM intensity is lower in the deepest interval as a result of the replacement of pseudo single domain primary titanomagnetite by multidomain secondary magnetite.

(ii) that in another area of the Troodos ophiolite rapidly sealed crust of a contrasting constructional nature shows low alteration and strong magnetization from the sediment-volcanic surface downwards.

(iii) that within and adjacent to the sheeted dike interval at about 3 km crustal depth a number of well defined alteration-magnetic property zones succeed one another with depth. A well defined magnetic susceptibility low within the centre of the sheeted dikes is thought to be the result of the widespread replacement of secondary magnetite by high temperature, martitic hematite. The origin of zones of higher magnetization adjacent to this low are currently under investigation.

(iv) that in areas of high temperature upwelling, intense alteration, and associated reduction in magnetization, normally only seen at depth, is found within a few hundred metres of the sediment-volcanic surface.

(v) that the attempt to relate the occurrence of economic sulfide deposits to other features of Troodos type oceanic crust is ongoing, but has already produced evidence for regular thickness variation in the strike direction of the members of the ophiolite pseudostratigraphic sequence.

References

Hall, J.M. and Fisher, B.E. The characteristics of secondary magnetite in a profile through the dike component of the Troodos, Cyprus, ophiolite. Submitted to Can. J. Earth Sci., November 1986.

Hall, J.M., Fisher, B.E., Walls, C.C., Ward, T., Hall, S.L., Johnson, H.P., and Pariso, J. Magnetic properties, oxide petrography, and alteration in the Cyprus Crustal Study Project drillholes CY-1 and CY-1a. Submitted to the Initial Report Series, Cyprus Crustal Study Project, Vol. II, August 1986.

Hall, J.M., Fisher, B.E., Walls, C.C., Hall, S.L., Johnson, H.P., Bakor, A.R., Agrawal, V., Persaud, M. and Sumaiang, R.M. The vertical distribution and alteration of dikes in a profile though the Troodos ophiolite. To appear in Nature, 1987a.

FIELD OF RESEARCH / DOMAINE DE RECHERCHE
(Check one cocher la case appropriee)

☐ Biotechnology / Biotechnologie
☐ Food-Agriculture / Alimentation-Agriculture
☐ Communications and Computers / Telecommunications et informatique
☐ Industrial Materials and Processes / Materiaux et procedes industriels
☐ Energy / Energie
☒ Oceans / Oceans
☐ Environmental Toxicology / Toxicologie de l'environnement
☐ Open / Ouvert

Name/Nom: Professor Simon Haykin
Department/Département: COMMUNICATIONS RESEARCH LABORATORY, McMaster University
University/Université:
Phone number (optional)/N° de téléphone (facultatif): 525-9140 Local 4085 (416)
Title of Project/Titre du projet: ICE SURVEILLANCE IN THE ARCTIC USING SURFACE-BASED RADAR

For a number of years, the Communications Research Laboratory (CRL) of McMaster University has been conducting research into the use of surface-based radar for the detection and classification of sea ice and icebergs. In collaboration with the Canadian Department of Fisheries and Oceans (DFO), the CRL has participated in four field trips to the Arctic in which the radar returns from sea ice and icebergs were recorded. Radars were operated at four frequencies, all radars were noncoherent, but some provided dual linear polarized operation. These experiments showed that the marine radars in use at the present are inadequate for providing the performance required by those operating in ice-infested waters, notably bulk carriers, tankers, and drilling platforms. Analysis of the recorded data showed the utility of cross-polarized radar information for classification of ice type into first-year, multi-year, or iceberg.[1] The latter two types represent a significant collision hazard to a navigating vessel or rig. Cross-polarization also enhances the ability of the radar to detect icebergs in an open water environment.[2] The data analysis showed the higher radar frequencies provide stronger ice returns, a better ability to distinguish ice types, and a higher resolution capability for a given physical antenna size. Countering this is increased atmospheric propagation loss and increased hardware costs. The X-band radar is a reasonable compromise.

To meaningfully continue its ice radar design research, the CRL successfully applied for an NSERC Strategic Grant to design and construct a radar specifically for use in ice radar experimentation. The radar construction has just been completed, and an extensive testing program is underway.

The radar has been designed to incorporate:

(a) Coherence - allowing the measurement of Doppler shifts, hence, target velocities. The iceberg and sea clutter spectra will differ sufficiently to allow improved detection of the iceberg.

(b) Pulse Compression - allowing improved radar range resolution with modest transmitter power. The improved resolution will aid both the imaging and detection operations.

(c) Dual Polarization - which has shown itself to be useful for both ice type classification in an ice cover, and iceberg detection in open water.

(d) Antenna Design - which provides typical marine antenna beam pattern, narrow in beaming but wide in elevation, but with dual-polarized operation and very low sidelobes, improving the resolution.

(e) Built-in Calibration - allowing in-the-field quantification of the radar's characteristics and verification of its proper operation. Variations in the experimental data must be known to be due to external phenomena, not the radar itself

The CRL has recently applied for a Cooperative Research and Development grant to support the transfer of CRL's ice radar technology to a Canadian radar manufacturer.

References: [1] Proc. IEEE, "Surface-Based Radar Imaging of Sea Ice", 1985.
[2] IEEE Int. Radar Conf., "Effect of Polarization on the Marine Radar Detection of Icebergs", 1985.

SUMMARY FOR PUBLICATION/RÉSUMÉ À PUBLIER

FIELD OF RESEARCH / DOMAINE DE RECHERCHE
(Check one/cocher la case appropriée)

☐ Biotechnology / Biotechnologie	☐ Communications and Computers / Télécommunications et informatique	☐ Energy / Énergie	☐ Environmental Toxicology Toxicologie de l'environnement
☐ Food-Agriculture / Alimentation-Agriculture	☐ Industrial Materials and Processes / Matériaux et procédés industriels	☑ Oceans / Océans	☐ Open / Ouvert

Name/Nom: D. A. Huntley

Department/Département: Oceanography

University/Université: Dalhousie University

Phone number (optional)/N° de téléphone (facultatif): (902) 424-3557

Title of Project/Titre du projet: The Movement of Water and Sediment at the Sea Bed

Continuing research begun with a previous Strategic Grant, this Grant provided support for two cruises onto the Nova Scotia continental shelf to study waves, currents and turbulence within 1 m. of the sea bed. In July 1984 our tripod of electromagnetic current meters and heated thermistor anemometers was deployed onto the sea bed in 25 m water depth off Halifax, N.S. and the second deployment, in September 1984 was in 45 m depth on Sable Island Bank.

The incentive for this work was the need to improve our understanding of the processes operating at the sea bed, with the aim of providing better predictions of both hydrodynamic forces and sediment motion in a region important to the fishing and oil and gas industries. The primary hypothesis being tested was that the bottom stress due to a mean flow is greatly enhanced by the presence of wave motion added to the mean flow. If true this hypothesis has important consequences particularly for the prediction of wind-driven and other flows and for sediment transport on the continental shelf.

Our results have proved interesting in two regards. Firstly our data analysis has lead us to suggest a useful extension of an existing method for determining the force imposed on the sea bed by the water motion, using the measured turbulence at the bed. Re-analysis of previous data and our own data suggests that our technique works well. Secondly the measured stresses support the hypothesis that stress is enhanced by the presence of waves. In fact existing theory appears to predict the enhanced stresses fairly well, though there are indications that the theory underestimates the wave influence and this might become increasingly important as conditions become more extreme.

Name/Nom: J.W. Kamphuis
Department/Département: Civil Engineering
University/Université: Queen's University
Phone number(Optional)/N° de téléphone (facultatif): 545-2122
Title of Project/Titre de projet: Research on the Hydraulic Modelling of Artificial/ Sand Islands

2. SUMMARY OF PROJECT

Title: Research on Hydraulic Modelling of Sand Islands

A scale series of 57 hydraulic models of the same sand island prototype were built and tested in order to develop further understanding of how to model extensive and complex coastal systems hydraulically using a mobile bed. This work has allowed insight into the various critical parameters involved in such modelling.

In addition, several models of caisson retained islands and several models involving protective structures were also built to demonstrate that existing methods may be improved by innovative use of materials.

The achievements of the project may be summarized as:

a. A very extensive data base now exists which can be used to improve both hydraulic and numerical modelling techniques.

b. A better insight into scale effects has been obtained.

c. Two engineers, 2 Ph.D. students, 6 M.Sc. students and 5 undergraduate students were trained on this project.

d. A body of knowledge has been and will be made available to the industry and the engineering profession through personal contact, seminars and through the publication of at least 10 papers.

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Title of Project/Titre du projet: Plankton rate processes in oligotrophic and coastal oceans

The primary objective of the project was to determine phytoplankton carbon turnover rates and pool sizes to help elucidate the pathways of carbon and energy flow from the phytoplankton up the food chain in both coastal and offshore marine environments. A secondary objective was to compare classical shipboard incubation techniques with experiments using large volume in situ enclosures.

The principal technique applied was long-term incubation of phytoplankton with inorganic radiocarbon followed by determination of the organic radiocarbon accumulation at the species level using track autoradiography and at the community level using filtration techniques. The species carbon content was calculated from cell radiocarbon content at saturation while the rate of assymptotic approach to saturation permitted calculation of the carbon pool turnover rate.

Offshore studies were part of the multidisciplinary PRPOOS (Plankton Rate Processes in the Oligotrophic OceanS) project which was funded by the U. S. National Science Foundation. NSERC Strategic Grant funds were used to support shore laboratory costs. Experiments conducted in the coastal waters of Newfoundland formed the core of an M. Sc. thesis completed by a graduate student at Memorial University.

Initial field work showed that offshore phytoplankton populations had very small carbon pools, on a weight:volume basis, and that the pools were turning over rapidly. This turnover did not result in growth, however; incorporated carbon was rapidly respired either by the phytoplankton directly or, most probably, by closely coupled bacteria and other heterotrophs. Subsequent experiments with inshore bloom populations and with nutrient enrichment of offshore waters demonstrated increased carbon pools and a shift in disposition of the fixed carbon into growth and cell division. Carbon uptake measured in large-volume, in situ bags was comparable to that measured on shipboard in 20 l polycarbonate carboys which were carefully acid washed to preclude trace metal contamination.

Analysis of the kinetics of tracer uptake revealed violations of basic assumptions and resultant underestimates of the actual carbon flux rate. The impact of these findings on the historical data record is currently being evaluated. It is likely that our current concepts of carbon and energy flow in the ocean will require revision.

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FIELD OF RESEARCH / DOMAINE DE RECHERCHE
(Check one cocher la case appropriee)

☐ Biotechnology / Biotechnologie
☐ Food-Agriculture / Alimentation-Agriculture
☐ Communications and Computers / Telecommunications et informatique
☐ Industrial Materials and Processes / Materiaux et procedes industriels
☐ Energy / Energie
☒ Oceans / Oceans
☐ Environmental Toxicology / Toxicologie de l'environnement
☐ Open / Ouvert

Name/Nom: George O. Mackie
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Title of Project/Titre du projet: Impact of "jellyfish" predation upon fish larvae

The goals of the present research were to identify important jellyfish predators of larval fishes in British Columbia, and to estimate predation rates in situ. The yearly objectives were in 1983 to examine predation throughout the spring, in 1984 to examine geographic variations in predation, in 1985 to estimate the percentage of the disappearance of hatching herring larvae that could be attributed to predation, and to compare predation impacts over the duration of the study. Two herring spawning grounds on Vancouver Island were sampled in 1983-85; the Lambert Channel/Baynes Sound, and the Kulleet Bay/Yellow Point areas. Eighteen additional sites were sampled in 1984 on Vancouver Island, the north and south B.C. mainland coast, and on the east coast of the Queen Charlotte Islands. The same sampling gear and methods were used in all cases to ensure direct comparability (0.75 m-diameter, 333 um mesh plankton net). In order to determine predation rates, the numbers of herring larvae in jellyfish stomachs were divided by the time required for digestion of a larva. This, in combination with data on herring larva and jellyfish abundance, yielded estimates of the percentages of the larval population being consumed. The major conclusions are as follow:

1. Aequorea victoria, a hydromedusa species found to about 7 cm in diameter, was the only fish larva predator present when the herring larvae hatched in 1983 and 1985.

2. The diet of A. victoria consisted of as much as 80% herring larvae at hatching, and included fish larvae in 5 other families, and pelagic fish eggs.

3. Predator populations differed greatly among the numerous spawning grounds sampled in 1984. Predator densities were high in bays and inlets, but low along exposed shores.

4. The numbers of herring larvae found in A. victoria were directly related to the larval abundance. This provides a means of predicting predation rates in situ, given only the abundances of larvae and medusae.

5. The population of A. victoria in Kulleet Bay increased 100-fold between 1983 and 1985. In 1985, the predation impact on herring larva populations there was devastating.

Publications.

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Purcell, J.E., T.D. Siferd, and J.B. Marliave. 1986. Vulnerability of larval herring (Clupea harengus pallasi) to capture by the jellyfish Aequorea victoria. Mar. Biol., in press.

Four other papers are currently in preparation.

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Title of Project/Titre du projet: "Impact de la glace sur les ouvrages de génie civil à parois inclinées"

Cette recherche avait pour objectif l'étude expérimentale des forces exercées par la glace sur les ouvrages de Génie civil, le long des côtes et des voies navigables.

Cette recherche a été effectuée dans un bassin d'environ 4m x 5m en chambre froide. L'objectif plus précis de la recherche était de déterminer tous les mécanismes de rupture pour des parois à angles différents et de mesurer la force maximale, au premier contact d'un indenteur plat avec un champ de glace semi-infini.

Pour des indenteurs faisant 90° avec la plaque, nous avons déterminé tous les mécanismes de rupture et les valeurs à utiliser pour les coefficients d'indentation, et ceci dans les domaines ductile, fragile et de transition.

Pour les indenteurs inclinés à différents angles avec la verticale, la première force et les mécanismes de rupture sont les mêmes dans le domaine fragile pour les indenteurs inclinés vers le haut ou vers le bas. La composante verticale de la force peut être obtenue en prenant le résultat de la théorie de la rupture circonférentielle sans tenir compte des fissures radiales. Par contre, dans le domaine ductile, pour un indenteur incliné vers le haut, il faut tenir compte, dans l'interprétation des résultats, de la théorie de la rupture d'un ensemble de pointes contigues. Il est bien évident, dans ce cas, que les fissures radiales apparaissent bien avant la fissure circonférentielle. Enfin, pour un indenteur incliné vers le bas, la plaque de glace s'enfonce continuellement sous l'eau après avoir été soumise aux fissures radiales et on n'atteint pas de force maximale dans nos essais.

Références

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PICARD, F. (1987) "Etude expérimentale de l'interaction entre une nappe de glace flottante et une structure inclinée à différentes vitesses". Thèse de maîtrise, Université Laval, Génie civil, 250 p.

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Title of Project/Titre du projet: Investigation of Water Colour Interpretation For Case II Waters

In situ water quality and water optical measurements were carried out at 24 stations in Lake Ontario near mid-lake and in the vicinity of the Niagara River plume and in mid Lake Huron in 1984 and 1985. Optical measurements consisted of depth profiles of the up and downwelling spectral irradiance (380nm to 694nm), the beam extinction coefficent at 630nm and the above-surface spectral reflectance. Analysis of the depth dependence of the downwelling spectral irradiance permitted the determination of the spectral dependence of the diffuse attenuation coefficient for several Lake Ontario stations. Water samples from all the Lake Ontario stations showed that near-surface concentrations of chlorophyll, suspended solids and dissolved organic carbon varied by less than a factor of 5 (chlorophyll + phaeophytins 1.6 to 5.9 mg/m^3 ; TSS 1 to 5 g/m^3 and dissolved carbon 1.5 to 5.3 g/m^3). The Lake Huron stations provided water with less than 0.2 mg/m^3 chlorophyll.

All reflectance spectra from Lake Ontario (except two mid-lake stations) were similar in character to typical published spectra for Case II waters. The spectra from mid Lake Huron were similar to Case I water spectra.

Using both subsurface irradiance reflectances and above-surface radiance reflectances from Lake Ontario and from Lake Huron (only 2 points), regressions of chlorophyll and 440/550 reflectance ratios yield a relationship showing general agreement with published coefficients but with a rather poor correlation coefficient. Similar analysis on our Lake Ontario data alone show these factors to be almost totally uncorrelated. This unexpected apparent lack of correlation is attributed to the small variation in pigment concentration in Lake Ontario. This conclusion is supported by a regression analysis of published bio/optical data in which the CZCS algorithm correlation coefficient decreases from 0.91 to 0.24 when the published data set is reduced to include only the chlophyll concentration range observed in our Lake Ontario data.

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University/Université: Alberta
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Title of Project/Titre du projet: **An Integrated Study of Precious and Base Metal Mobilization in Hydrothermally Altered Oceanic Crust**

The igneous oceanic crust is altered by seawater as it cools and ages. We determined in detail how the distribution of gold in the deepest DSDP Hole 504B was affected by the various alteration regimes. The main conclusion is that even though very low in abundance gold is sufficiently mobile in the oceanic crust to have caused large economic gold ore deposits. Specifically, we found both localized enrichment and depletion of gold in the uppermost (320 m) low temperature (0 to 150°C) alteration zones but with no net change. The sulfide mineralized stockwork zone had the highest Au content we analyzed but overall it also showed no significant addition or loss of gold. In contrast to the above zones, the deeper greenschist facies zone was pervasively and uniformly leached of Au by hot (~350°C) seawater. The change in Au-content in the individual samples is measured in less than ppb but such large volumes of oceanic crust are produced and altered each year that about 4,100 kg of gold are leached annually from the oceanic crust. That gold may be deposited in the sulfide mounds and/or dispersed in deep sea iron rich sediments. The mobility of gold in basalts altered by fresh water was investigated on Iceland. We found that gold is relatively mobile in this basalt-hosted, shallow, meteoric water dominated system and can be effectively concentrated at sites of fluid upflow.

Active gold mines and prospects were investigated in dismembered ophiolites in the accreted oceanic/island arc terranes of the Canadian Cordillera. Surprisingly, no evidence of seawater was found, but rather, the ore fluids were shown to be highly evolved, (low δD but high $\delta^{18}O$) meteoric waters. A striking correlation exists between the distribution of these gold deposits and the location of major right-lateral transcurrent faults. There appears to be a km scale, vertical zonation sequence along these mineralized regions which consists of Au mineralization at depths with Sb ± Au, W mineralization at shallower depths followed by Hg ± Sb near the surface. We suggest that local meteoric water penetrated deep within the crustal slivers to the brittle ductile transition zone where extensive oxygen exchange occurred. The exiting evolved fluids were focused in the off-axis, subsidiary fault systems where the Au, Sb, Hg and gangue minerals were deposited. These high ^{18}O deposits contrast markedly from the previously known, "volcanic hot spring" type epithermal Au deposits, characterized by low ^{18}O ore fluids.

The data and our models improve exploration strategies for Au- load deposits e.g. The high ^{18}O- Au deposits presumably are of great extent connecting in a regional sense with Sb and Hg deposits whereas the low ^{18}O epithermal deposits will be more confined and more Ag rich, etc. We also suggest that our models apply to the economically more significant Archean gold deposits and exploration strategies for them need revision as well.

Name/Nom: S. Pond. P.H. LeBlond
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University/Université: British Columbia
Phone number(Optional)/N° de téléphone (facultatif):
Title of Project/Titre du projet: Horizontal structure and dynamics of low frequency velocity and density variations in the Strait of Georgia.

Low frequency (periods greater that three days) current and density fluctuations were observed in the central Strait of Georgia from June 1984 to January 1985. An array of four cyclesondes moorings (automatically profiling internally recording current meter and water property measuring systems) and five current meter moorings with instruments at 100, 200 and 290 m were deployed. The array was a hexagonal with a triangle inside. The sides of the hexagon were three nautical miles (5.6 km) and of the triangle one and a half nautical miles (2.8 km). Data recovery was 100% for the current meters and 95% for the cyclesondes.

Analysis of the data have included calculation of mean velocities, auto and cross spectra, vertical profiles of kinetic energy, empirical orthogonal functions to show the horizontal and vertical structure, coherence with the driving forces of the winds and long period tides and transverse and longitudinal correlation functions. We have finally been able to show that the low frequency motions are linked in large part to the long period tides and winds. The motions generated appear to be quite unstable so that the energy spreads to other frequencies obscuring the links. The results indicate that non-linear effects and friction, both vertical and horizontal, are important in the dynamics and that both barotropic and baroclinic instability may be important. The results provide test data for a three dimensional model being developed for the Strait of Georgia by Dr. P. Crean, Institute of Ocean Sciences, Patricia Bay, B.C., Fisheries and Oceans, Canada.

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Stacey M.W., Pond, S., LeBlond, P.H. Detection of subsurface eddies in the Strait of Georgia and an analysis of the dynamics of the low-frequency currents using the technique of objective analysis (submitted to Atmosphere Ocean in December 1986).

Stacey, M.W., Pond, S., LeBlond, P.H. Geostrophy and stability tests in the Strait of Georgia (submitted J. Mar. Res. December 1986).

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Title of Project: Salt finger and diffusive fluxes at low values of the stability ratio.

Salt fingers are a gravity-driven type of turbulence which mix sewage vertically near outfalls, and drive horizontal mixing of pollutants and nutrients across fronts at the edge of the continental shelf. It is not currently possible to directly measure the fluxes due to salt fingers; they must be inferred from other types of measurement, and extrapolated from laboratory measurements. The fluxes are largest at low values of the "stability ratio", where the stabilizing density contrast is exceedingly small. Hence these fluxes are most important in the parameter range where they are most difficult to measure, and the oceanic influxes cannot be quantified without laboratory measurements.

We have used a new configuration of laboratory experiment which alleviates the practical difficulties, to do two things.

1. We have made accurate measurements of the salt and heat fluxes across a salt finger interface at values of the stability ratio ranging from R=1.1-3. These agree well with previous measurements made at large R, but show substantially smaller fluxes at low R than had previously been measured by conventional techniques. This difference may explain discrepancies between observed oceanic turbulent dissipation rates and estimated fluxes (extrapolated from the laboratory) discussed by Larson and Gregg (Nature, 1983).

In addition, we have directly compared the buoyancy fluxes across a thermohaline diffusive interface (the exceedingly sharp interface which forms between cold snow-melt water and warmer sea-water) with salt finger fluxes. Both types of mixing are involved in the evolution of thermohaline intrusions across ocean fronts, as at the shelf break. As well as refining estimates of interface fluxes, we have discovered that there is an "attractor" behavior: all initial conditions tend towards the same final state. This gives us robust predictions of the eventual end-state of such fronts which have been observed in a "run-down" ocean eddy. The understanding of this behavior is an exciting area of current research which will lead to further understanding and quantification of intrusive layer formation at oceanic fronts.

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Title of Project/Titre du projet: Investigations of Mid-Ocean Ridges and Polymetallic Sulphide Deposits Using and Electric Rock-Core Drill

The Dalhousie/BIO rock core drill was successfully operated on cruises off Bermuda, on the Mid Atlantic Ridge (Kane Fracture Zone) and on Middle Valley of the Endeavour Segment of the Juan de Fuca Ridge in 1984, 85 & 86 respectively. The 1984 cruise marked the first occasion on which the drill operated consistently in water depths in excess of 2900m with core recovery on 10 out of 11 holes (lengths 11-68 cm). This cruise also marked the transition to operation and maintenance of the drill by Dalhousie personnel.

The Mid-Atlantic Ridge cruise had been planned as a two-phase effort with drilling in plutonic rocks on the western wall of the eastern ridge-transform intersection of the Kane Fracture Zone and completion of a line across the Median Valley at 36° 25'N which had been started in 1982. Due to winch problems drilling was terminated after two and a half days. We recovered two short basalt cores, two meter-long gabbro cores and one short gabbro core. The last two of these were from depths greater than 3100m. The drill-mounted television worked moderately well but picture quality was unreliable and durability of the lights was a major problem possibly due to the mechanical shocks involved in drill handling. Preliminary study of the gabbros has shown a weak intensity of magnetization - about a quarter of that reported from dredged gabbros and a scatter of directions along a single core. Consequently the gabbro is an unlikely source layer for the observed magnetic anomalies.

Drilling on the Juan de Fuca Ridge was also shortened due to unpredictable events namely a failure of handling equipment and bad weather. However in the little time available we did recover a sulphide core when the drill penetrated five meters of unconsolidated mud, which was not recovered, then approximately 45 cm of sulphidic material, along with the sediment - sulphide interface, which were recovered. The solid sulphide core pieces are each 5 to 10 cm long. The sulphide cored very well, and the condition of the drill core was identical with that recovered from preserved deposits. It consists of massive pyrite and pyrrhotite with economically significant quantities of zinc (1.4 to 8.6%) and copper (0.7-1.3%).

In conclusion we now have an operational tool capable of drilling rock core in water depths down to 3500 meters. Since the drill barrel is 6m long, core can be recovered from bare rock or rock covered by up to 5m of sediment. Further development is required to make the television a reliable aid to site selection. A description of the drill is given in:

Ryall, P.J.C. (1986) Remote Drilling Technology, Marine Mining, 6. (In press).

Early Scientific results based on drill cores form the Mid-Atlantic Ridge are discussed in:

Walker, J., Ryall, P.J.C., Zentilli, M., Gibson, I. and Dostal, J. (1985) The Origin of compositional variation in basalts recovered by submersible drill from Mount Glooscap, Mid-Atlantic Ridge at 36° 25'N. Canadian Journal of Earth Sciences 21, 934-948.

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Title of Project/Titre du projet: Studies of Wave Induced Diffusion

Mixing processes in the ocean result from motion that is difficult to describe mathematically. Dye and drifter experiments have lead to the formulation of empirical laws that describe ocean diffusion. Perhaps the best known empirical law is that horizontal eddy-diffusivities vary as scale raised to a power of four-thirds. In this project we showed that a spectrum of internal waves, similar to the Garrett-Munk spectrum, results in four-thirds eddy-diffusion law for scales in the range 20 to 500 m. This is an important advance because it relates, by analytic calculation, the diffusion process to dynamical forces. Eddy-diffusion caused by surface gravity waves has also been calculated and is being studied further.

We have extended our understanding of the Lagrangian diffusion equation and Lagrangian coordinates by studying simple cases of advection and diffusion. It can be shown that the usual distinct particle type of definition of Lagrangian coordinates is inconsistent with the diffusive process!

Finally a new method has been developed for solving the Lagrangian diffusion equation in a sophisticated advective field of motion. In the ocean it is reasonable to treat diffusivity as a small parameter, in order to make the Lagrangian diffusion equation mathematically tractable, providing a realistic and sophisticated advective field of motion can be specified. The usefulness of this approach for describing the distribution of plankton is presently being studied.

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Title of Project/Titre du projet: Sea Urchin Disease: Ecologic and Economic Implications

Between 1980 and 1983, recurrent outbreaks of disease caused mass mortalities of sea urchins (Strongylocentrotus droebachiensis) along the Atlantic coast of Nova Scotia. The goals of our research were 1) to determine the cause of this disease and its relationship with environmental factors, 2) to examine the impact the sea urchin die-off on the subtidal ecosystem, and 3) to assess the potential use of this disease as a means of biological control of sea urchins.

We have identified the pathogenic agent as a previously undescribed marine amoeba (Paramoeba invadens). We can culture this amoeba using marine bacteria as food and reproduce the disease in the laboratory, either by injecting sea urchins with amoebae from culture or by exposing them to infected individuals. Laboratory and field studies indicate a direct relationship between temperature and the transmission and progression of the disease, with a lower threshold around 10-12°C. Outbreaks of disease in nature have been associated with unusually warm summer/fall seawater temperatures (16-18°C). When the amoebae exhibit maximum growth rates and sea urchin resistance may be reduced.

Diseased sea urchins are characterized by a progressive degeneration of muscle and connective tissue resulting in a loss of function of the tube feet, spines, and mouth. The mechanism of pathogenicity remains obscure, but may involve enzyme or toxin production by the amoeba or activation of autolysis in the sea urchin. Amoebae are sparsely distributed in diseased sea urchins; they circulate in fluid-filled body cavities and migrate into and out of tissues. The amoeba appears to be highly host specific. Lobsters, crabs, snails and starfish scavenge diseased sea urchins, but show no signs of infection by amoebae. Other species of sea urchins show some susceptibility to infection, but the incidence of symptomatic disease is low.

Outbreaks of disease have effectively eliminated sea urchins over 300 km of coastline and the estimated loss of sea urchin biomass is more than 260 million tonnes. These mass mortalities have enabled the establishment of luxuriant kelp beds in areas previously characterized as sea urchin-dominated barren grounds. Along the exposed coast, kelp beds have attained a biomass of 7-9 Kg m^{-2} within 3 years. We expect that the associated increase in primary production and habitat complexity will lead to increased consumer production, including commercially important species such as lobster. Computer models indicate that while several mechanisms have the potential to cause dramatic shifts in this ecosystem, sea urchin disease is the only one to do so in eastern Canada. Sea urchins are recruiting to disease-affected areas via planktonic larvae, but variable recruitment success and low rates of growth and survival of juveniles indicate that it may be many years before sea urchin populations recover to the point at which kelp beds are threatened.

Our pathological and ecological studies indicate that the pathogenic amoeba could potentially be used to control sea urchin populations and thereby increase the productivity of coastal areas and the commercial yield of plant and animal resources.

Publications: Hagen, N.T. In Press, Sarsia 71; Jones, G.M. & N.T. Hagen In Press, Sarsia 71; Raymond, B.C. & R.E. Scheibling In Press, J. Exp. Mar. Biol. Ecol; Johnson, C.R. & K.H. Mann In press, Ecology; Johnson, C.R. & K.H. Mann. 1986. J. Exp. Mar. Biol. Ecol. 96: 127-146; Johnson, C.R. & K.H. Mann. 1986. J. Exp. Mar. Biol. Ecol. 97: 231-267; Scheibling, R.E. 1986 Oecologia 68: 186-198; Jones, G.M. 1985 J. Protozoology 32: 564-569; Jones, G.M. & R.E. Scheibling 1985 J. Parasitology 71: 559-565; Jones, G.M., A.J. Hebda, R.E. Scheibling & R.J. Miller 1985 J. Invert. Path. 45: 260-271; Jones, G.M., R.E. Scheibling, A.J. Hebda, & R.J. Miller 1985 In, Proceedings of the Fifth International Echinoderms Conference, Galway, pp. 289-294; Scheibling, R.E. 1984 Helgolander Meer. 37: 233-242; Scheibling, R.E. 1984 J. Fish. Aquatic Sci. 41: 1847-1851; Scheibling, R.E. & R.L. Stephenson 1984 Mar. Biol. 78: 153-164.

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Title of Project/Titre du projet: YOUNG SEAMOUNTS OF THE NORTHEAST PACIFIC OCEAN

Our three-year Strategic project has focussed on locating metal sulfide - producing hot springs on the ocean floor and on their detailed geological, mineralogical and geochemical examination at 5 sites in the eastern Pacific and 1 in the western Pacific. New hydrothermal vent fields were discovered at 3 sites using chemical and physical remote sensing techniques and the Canadian PISCES IV submersible. Our most notable achievement was on Explorer Ridge off Canada's west coast where large (3-5 x 10^6t) sulfide deposits were discovered. Fifteen analyses average 8% Cu, 9% Zn, 112 ppm Ag and 1 ppm Au. We have also worked on hydrothermal vent sites in the caldera of Axial Seamount, Juan de Fuca Ridge (co-discoverers); at 11°N on the East Pacific Rise; in the sedimented Guaymas Basin, Gulf of California; at Tuzo Wilson Seamounts, south of the Queen Charlotte Islands; and in Woodlark Basin, western Solomon Sea. Our research has demonstrated relationships among tectonics, host-rock composition and sulfide mineralization, including controls on gold distribution, which will provide a better understanding of and new exploration guides for ancient base and precious metal massive sulfide ores on land which annually provide about 1/4 of Canada's mineral wealth.

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57

Theses (4 M.Sc. completed) are not listed.
Refereed Abstracts (total 41) are not listed.

(Check one cocher la case appropriée)

- ☐ Biotechnology / Biotechnologie
- ☐ Food Agriculture / Alimentation-Agriculture
- ☐ Communications and Computers / Telecommunications et informatique
- ☐ Industrial Materials and Processes / Matériaux et procédés industriels
- ☐ Energy / Énergie
- ☐ Oceans / Océans
- ☒ Environmental Toxicology / Toxicologie de l'environnement
- ☐ Open / Ouvert

Name/Nom: John B. Sprague
Department/Département: Zoology
University/Université: Guelph
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Title of Project/Titre du projet: Flux of cadmium through an arctic marine ecosystem

Flux of cadmium through an arctic marine ecosystem

Marine mammals in the Canadian eastern Arctic contain extremely high levels of cadmium, much higher than comparable mammals from southern or European locations. Eastern Arctic ringed seals, for example, have ten times the body burden of cadmium found in Baltic ringed seals. The reason for this was not known, and in the past there has been speculation about pollution or a general elevation of cadmium in arctic ecosystems. Our project had the objective of explaining why there was elevated cadmium in the mammals, using ringed seal as a representative animal.

Initial modelling suggested that differences of diet between arctic and European seals could account for cadmium levels. Since cadmium levels in food organisms were poorly known, collections of fish, invertebrates, and algae were made in four sampling trips to the eastern Arctic. All groups were similar in cadmium content to organisms from southern locations as reported in the literature. Thus there is no general elevation of cadmium in the Arctic seas.

Notable among these measurements were low levels of cadmium in fish (Arctic cod, 0.4 ug Cd/g dry body weight) and high levels in large crustaceans (hyperiid amphipods) (12.4 ug Cd/g dry weight). The values are the same as for southern species. However Canadian ringed seals have a diet that is mostly crustaceans during their first two years of life, and about 75% crustaceans during the summer, for older seals. In winter the older seals subsist largely on Arctic cod. European and southern seals, in contrast, switch at an early age to a diet that is almost entirely fish. A computer-based model was used to predict cadmium levels in seals, using the known diets and human values for rates of cadmium absorption and clearance. The model predicted the observed values for Baltic seals accurately. Predicted values for Canadian seals were as high as the highest of observed values. It was concluded that dietary differences were more than sufficient to account for elevated cadmium in the Canadian mammals. Suspicious of pollution, or general elevation of cadmium have been laid to rest.

Name/Nom: Peter J. Wangersky
Department/Département: Oceanography
University/Université: Dalhousie
Phone number(Optional)/N° de téléphone (facultatif): (902) 424 3672
Title of Project/Titre du projet: The sources, nature, and size distribution of particles in the ocean

The distribution of particles with depth in the ocean was studied using a backscatter photometer - camera system devised in our own laboratory. The heterogeneity of particle distribution was confirmed, with clouds or layers of particles accumulating at density discontinuities and in a nepheloid layer near the sea floor. A portion of this layer appeared to shift position in the water column with time of day, leading us to suspect that the layer was composed of zooplankton. Photographs taken of layers rich in particles demonstrated the ability of the photographic system to distinguish copepods and diatom chains. The backscatter photometer can be connected to a CSTD, and with an attached computer and printer will furnish real-time plots of backscatter, temperature, salinity, dissolved oxygen against depth.

A multi-angle (2 - 177°) light scattering meter has been designed, built, and tested. The unit measures the volume scattering function of a seawater sample in two perpendicular polarizations of incident light at 633 nm. Work done with this meter, and with the scanning electron microscope, suggests that the particle size distribution in seawater reaches a maximum around 1 um, and then decreases with decreasing size.

An in situ pump sampler, designed and built in this laboratory, has been used to collect and study the free and organically-bound Cu, Cd, and Zn in the water column. Values of free metals found with this concentrating sampler are much like the currently accepted values for open-ocean samples. A study of the lipid classes in phytoplankton during blooms and in turbidostat cage cultures has shown a shift from the normal array of lipids to a predominance of triglycerides at the advent of nitrogen stress.

The formation of organic aggregates by the mechanisms of surface coagulation and filtration has been modelled and studied in the laboratory. Anomalous results in the early work on particle formation have been explained. The incorporation of trace metals into particles formed by bubble solution and bubble bursting has been demonstrated in the laboratory and in the field, with enrichments of 2.5 - 20 found for different metal ions. The concentration of bacteria on such particles, followed by the consumption of the aggregates by the bacteria, has been demonstrated in laboratory systems.

This grant has so far produced 2 Ph.D. theses, 14 published papers, 6 papers submitted, and a further number still in manuscript. Representative papers:

Johnson, B.D., & P.J. Wangersky (1985). A recording backward scattering meter and camera system for examination of the distribution and morphology of macroaggregates. Deep-Sea Res., 32:1143-1150.

Wangersky, P.J. (1986). Biological control of trace metal residence time and speciation: a review and synthesis. Mar. Chem., 18:269-297.

Jonasz, M. (1986). Nonsphericity of suspended marine particles as determined using scanning electron microscopy. Limnol. Oceanogr., accepted Feb. 1986.

Parrish, C.C., and P.J. Wangersky (1987). Particulate and dissolved lipid classes in cultures of Phaeodactylum tricornutum grown in cage culture turbidostats with a range of nitrogen supply rates. Mar. Ecol. Prog. Ser., 35:119-128.

Johnson, B.D., & P.J. Wangersky (1985). Seawater filtration: Particle flow and impaction considerations. Limnol. Oceanogr., 30:966-971.

REGULATIONS GOVERNING THE USE OF GRANT FUNDS
(Excerpts from the 1986-87 Awards Guide) /

RÈGLEMENTS RÉGISSANT L'UTILISATION DES SUBVENTIONS
(extraits du Guide des subventions 1986-1987)

Description

86. Strategic grants are offered to individuals and groups to assist with the direct operating costs of research projects (including the organization of workshops and seminars) or with the purchase of equipment essential to the pursuit of research projects in the following areas:

- biotechnology
- communications and computers
- energy
- environmental toxicology
- food and agriculture
- industrial materials and processes
- oceans

In addition, through an "open" area, researchers may submit proposals in fields of national concern other than the seven designated areas.

Although individual applications are considered, group applications with a multifaceted approach are encouraged.

Strategic conference grants assist with the organization of conferences in areas of national concern.

Strategic Equipment Grants

104. Strategic equipment grants must only be used to purchase the equipment for which the grant was awarded. If recipients of strategic equipment grants do not require the full amount awarded for this purpose, they must refund the balance to NSERC. A researcher who is not able to purchase the equipment specified, or who wishes to select alternative equipment, must submit a written request to NSERC outlining the reasons for the change. The modified request will be assessed and the grantee will be informed of Council's decision.

NSERC expects beneficiaries of strategic equipment grants to make operating time available to other interested researchers whenever possible.

General Principles

205. Grant funds must be used effectively, economically, and in the best interest of the research supported by the grant. The financial administration of grants and the conditions governing their use are not intended to restrict grantees, but to ensure good accounting and administrative practices.

The administration of NSERC grants is carried out by three parties: the grantee, the university and NSERC.

- The grantee approves expenditures in accordance with NSERC regulations (outlined in the Awards Guide or imposed as a condition of a grant) and with university policies.
- The university administers the grant funds and establishes appropriate policies, controls and systems to ensure that NSERC policies and regulations are followed.
- NSERC defines the conditions under which grant funds may be used, monitors the use of grant funds, and interprets its rules and regulations for the university and grantees.

Description

86. Les subventions thématiques sont accordées à des chercheurs individuels ou à des groupes pour aider à couvrir les frais directs de leurs projets de recherche (y compris l'organisation de colloques et séminaires) ou à acheter des appareils de recherche nécessaires dans les domaines suivants:

- alimentation et agriculture
- biotechnologie
- énergie
- matériaux et procédés industriels
- océans
- télécommunications et informatique
- toxicologie de l'environnement.

Il existe également un thème «ouvert», dans le cadre duquel les chercheurs peuvent soumettre des propositions dans des domaines d'intérêt national autres que les sept thèmes choisis.

Même si les demandes individuelles sont acceptées, le CRSNG encourage les chercheurs à présenter des demandes de groupe à caractère pluridisciplinaire.

Les subventions thématiques pour conférences soutiennent l'organisation de conférences dans des domaines d'intérêt national.

Subventions thématiques d'appareillage

104. Les subventions thématiques d'appareillage ne doivent être utilisées que pour l'achat de l'appareillage pour lequel la subvention a été accordée. On doit retourner au CRSNG tout montant non utilisé à cette fin. Un chercheur qui ne peut acheter l'appareillage décrit dans la demande ou encore qui désire choisir un autre appareil doit faire une demande écrite au CRSNG, en donnant les raisons du changement. Le CRSNG étudiera la demande et informera le bénéficiaire de sa décision.

Le CRSNG s'attend à ce que les bénéficiaires de subvention thématique d'appareillage mettent du temps de fonctionnement de l'appareil à la disposition d'autres chercheurs intéressés, lorsque cela est possible.

Principes généraux

205. Les subventions doivent être utilisées de façon efficace et économique, de manière à favoriser le plus possible la recherche subventionnée. L'administration financière des subventions et les conditions régissant leur utilisation n'imposent au bénéficiaire qu'un minimum de restrictions, mais exigent de bonnes pratiques comptables et administratives.

Les subventions du CRSNG sont administrées par trois parties: le bénéficiaire, l'université et le CRSNG:

- le bénéficiaire approuve les dépenses en se conformant aux règlements du CRSNG (décrits dans le Guide des subventions ou imposés lors de l'octroi de la subvention) et aux politiques de l'université;
- l'université administre les fonds et établit les politiques, les contrôles et les systèmes nécessaires pour assurer le respect des politiques et règlements du CRSNG;
- le CRSNG définit les conditions régissant l'utilisation des fonds, contrôle l'utilisation des fonds et interprète ses règlements pour l'université et les bénéficiaires.

This chapter describes the financial administration of grant funds and outlines the regulations governing their use. Grantees who wish to use their grant funds to purchase resources or services not covered by explicit NSERC guidelines must consult their research grants officer or business officer, prior to committing any NSERC grant funds to such a purchase. If there is no explicit NSERC guideline to answer a question or no university policy covering the subject, the research grants officer or the business officer will seek an appropriate ruling from NSERC.

Ce chapitre décrit l'administration financière des subventions et les règlements en régissant l'utilisation. Le bénéficiaire qui désire utiliser ses fonds pour acheter des ressources ou des services non prévus dans les directives explicites du CRSNG doit consulter le responsable de la recherche ou du service des finances avant d'engager une part quelconque des fonds du CRSNG pour l'achat envisagé. Si les directives du CRSNG ne peuvent répondre à une question, ou s'il n'existe pas de politique universitaire à ce sujet, le responsable de la recherche ou du service des finances s'en remettra au CRSNG pour obtenir une décision appropriée.

Fiscal Period

212. NSERC grants are awarded to cover expenditures incurred during a specific period of time termed the fiscal period. The fiscal period for operating grants commences on April 1 of the year of the initial award and may be for one, two or three years. The fiscal period for strategic grants commences on November 1 of the year of the initial award and may be for one, two or three years. If not otherwise specified in published program descriptions or in direct correspondence with grantees, the fiscal period for other awards is one year from the date of the award (see paragraph 213). Upon receipt of a written request, NSERC may extend the fiscal time period of the grant if it is considered to be in the best interest of the research.

Période financière

212. Les subventions du CRSNG couvrent les dépenses engagées pendant une période désignée période comptable. La période comptable des subventions pour dépenses courantes débute le 1er avril et peut durer un, deux ou trois ans. La période comptable des subventions thématiques débute le 1er novembre de l'année où la subvention est accordée et peut durer un, deux ou trois ans. À moins d'indication contraire dans la description du programme ou dans les conditions d'octroi, la période comptable des autres subventions dure un an à compter de la date d'octroi (voir l'article 213). Sur réception d'une demande écrite, le CRSNG peut prolonger la période comptable d'une subvention s'il juge que c'est dans le meilleur intérêt de la recherche.

Commitments

215. NSERC receives funds for its programs through annual parliamentary appropriations. Thus, all commitments for support beyond the current fiscal year (e.g., second and third instalments of two- and three-year grants) are made subject to the availability of funds. Under no circumstances is NSERC able to accept responsibility for commitments incurred by grantees that exceed the actual funds to their credit in the NSERC Common Grant Account at the university.

Engagements

215. Le CRSNG reçoit du gouvernement des fonds pour ses programmes de subventions et bourses sous forme de crédits parlementaires annuels. Le CRSNG prend donc des engagements pour les années financières postérieures à l'année courante (p. ex. les deuxième et troisième versements de subventions de deux ou de trois ans) sous réserve de la disponibilité des fonds. Le CRSNG ne peut donc accepter aucune responsabilité à l'égard d'engagements financiers qui dépassent les fonds disponibles dans le compte commun des subventions à l'université.

Indirect or Overhead Costs

219. The funds provided through NSERC grants in aid of university research must not be used to contribute to the payment of indirect or overhead costs of research.

Frais indirects ou généraux

219. Les bénéficiaires ne doivent pas utiliser les fonds octroyés par le CRSNG dans le cadre de ses programmes de subventions pour payer des frais indirects ou généraux de recherche.

Payment of Salaries and Stipends

222. NSERC grantees may use their research grant funds to contribute towards the payment of salaries or stipends of qualified people working in their laboratories on a part-time or full-time basis. However, grant funds must not be used to pay any part of the salary or employee benefit plans of the grantee, members of the grantee's immediate family, other staff members of a Canadian university whose status would make them eligible to apply on their own behalf for NSERC grants, or recipients of other direct NSERC support. Grant funds must not be used to employ secretaries, but may be used to pay for typing services for manuscripts and reports.

Salaires et traitements

222. Les bénéficiaires de subvention du CRSNG peuvent utiliser leur subvention de recherche pour payer les salaires ou traitements de personnes qualifiées travaillant à temps complet ou partiel dans leurs laboratoires. Cependant, ils ne peuvent s'en servir pour payer une partie du salaire ou les avantages sociaux du bénéficiaire, des membres de sa famille immédiate, des membres du personnel d'une université admissibles aux subventions du CRSNG ou encore des bénéficiaires d'autre forme d'aide directe du CRSNG. Ils ne peuvent l'utiliser pour employer une secrétaire, mais peuvent s'en servir pour payer les services de dactylographie pour les manuscrits et les rapports.

Persons in one of the following three categories may be employed under a grant:

— assistants employed to help grantees carry out their research (research associates, research assistants, undergraduate students, programmers, technicians and other technical and non-professional assistants);
— postgraduate students and postdoctoral fellows receiving a stipend to work under the grantee's supervision or as collaborators to the grantee; such persons may not, however, be paid from infrastructure grants;
— visiting scientists receiving transportation, meal and accommodation expenses and stipends (if they are not themselves eligible to apply for NSERC grants) when invited by grantees to collaborate with them.

Les personnes appartenant à l'une ou l'autre des catégories suivantes peuvent être rémunérées à même une subvention:

— adjoints engagés pour aider le bénéficiaire à réaliser son projet (attachés, adjoints de recherche, étudiants de 1er cycle, programmeurs, techniciens et autres adjoints techniques ou non professionnels);
— étudiants de 2e ou 3e cycle et stagiaires postdoctoraux recevant un traitement pour travailler sous la direction du bénéficiaire ou en collaboration avec lui; ces derniers ne peuvent toutefois pas être rémunérés à même une subvention d'infrastructure;
— scientifiques invités recevant des frais de déplacement, de repas et de logement et un traitement (s'ils ne sont pas eux-mêmes admissibles aux subventions du CRSNG) lorsqu'ils sont invités par le bénéficiaire à collaborer avec lui.

Summary of Salaries and Stipends from Grants

Assistants	
—subject to university policies	
Graduate students	
—per annum:	$10,560
—per month:	$ 880

Résumé des salaires et traitements payés à même les subventions

Adjoints	
—traitements assujettis aux politiques de l'université	
Étudiants (2e et 3e cycles)	
—par an:	10 560$
—par mois:	880$

Purchase of Equipment and Other Materiel

237. When purchasing equipment and materiel, grantees must follow university procedures related to purchasing. Grantees must explore the possibility of purchasing equipment manufactured in Canada. Refer to paragraph 249 concerning the purchase of powered vehicles.

Achat d'appareillage et de fournitures

237. L'acquisition d'appareillage et de fournitures doit respecter les politiques d'achat de l'université. Les bénéficiaires doivent étudier la possibilité d'acheter des appareils fabriqués au Canada. Consulter l'article 249 pour les règlements régissant l'achat de véhicules motorisés.

Ownership of Equipment and Other Materiel

238. All equipment and materiel (including specialized books and publications, small assets such as cameras, small calculators, binoculars, tents, skis, etc.) purchased with NSERC grant funds belong to the university and not to the individual grantee.

When a researcher is moving to another Canadian university and wishes to move equipment or other materiel purchased with NSERC grant funds, Council encourages the university to accede to such a request provided the equipment is not necessary for the research activities of other researchers at that university. Assets so moved will belong to the new university.

Propriété de l'appareillage et d'autres biens

238. Tout appareillage et autre matériel (y compris, les livres et publications spécialisés, appareils-photo, calculatrices, jumelles, tentes, skis, etc.), achetés grâce à une subvention du CRSNG appartiennent à l'université, et non au bénéficiaire.

Lorsqu'un chercheur déménage dans une autre université au Canada et qu'il désire apporter avec lui les appareils ou autres biens achetés avec l'aide financière du CRSNG, le Conseil encourage l'université à accéder à sa requête si les appareils ne sont pas nécessaires aux travaux d'autres chercheurs de l'université. Les biens ainsi déménagés appartiendront à la nouvelle université.

Computing Costs

241. Grant funds may be used towards payment of charges for machine time, programming services and other related expenses essential to the conduct of the research for which the grant was awarded.

Frais d'ordinateur

241. Les subventions du CRSNG peuvent servir à payer le temps-machine, les frais de programmation et autres frais connexes lorsque ces dépenses sont essentielles à la poursuite de la recherche pour laquelle la subvention a été accordée.

Patents

243. NSERC grantees are encouraged to seek patent protection for their inventions or developments, particularly in such a way that will benefit Canada. One method of accomplishing this is to consult with and use the services of Canadian Patents and Development Limited (CPDL). Many universities have an agreement with CPDL to achieve this end.

Publications

244. Grant funds may be used to purchase certain specialized publications not normally obtainable through the university library and that are essential to the research supported by Council. These may include special tables, catalogues of functions, published data, specialized journals and like material. Such publications belong to the university.

245. Grant funds may be used towards costs involved in the preparation of manuscripts, whether for articles in research journals or books, and towards the payment of page charges for publication in scientific journals. Grant funds must not, however, be used to pay for printing costs involved in the publication of a book.

246. Grantees are encouraged, whenever possible, to publish the results of their NSERC supported research in Canadian journals, including not only the Canadian Journals of Research published by the National Research Council, but other Canadian scientific and technical publications as well.

Acknowledgement of NSERC Support

247. In any publication arising from research supported by Council grants, acknowledgement of NSERC assistance is expected.

Travel Expenses

248. Grant funds may be used to pay transportation, accommodation and meal expenses incurred during brief trips away from the grantee's university when these are essential to the research funded through the grant. The expenses may be incurred by grantees or by persons working with or for the grantees. Such trips include field trips (e.g., to collect specimens or samples or to use facilities located elsewhere), trips to consult with colleagues and attendance at conferences, meetings, symposia, etc. Transportation to and from the location(s) of sabbatical leave and personal living expenses while at the place(s) of sabbatical leave are not allowable expenses from operating grants. However, field trips and conference travel during the period of sabbatical leave are allowable as specified above.

Research travel associated with leave in excess of three months is not normally considered a brief trip, but under certain circumstances may be supported through NSERC grants:

Brevets

243. Les bénéficiaires de subvention du CRSNG auraient avantage à protéger leurs inventions ou leurs découvertes particulièrement de façon à en faire bénéficier le Canada. Ils peuvent, à cette fin, consulter la Société canadienne des brevets et d'exploitation Limitée (SCBE) et recourir à ses services. Plusieurs universités ont conclu à cet effet un accord avec cette société.

Publications

244. Les subventions peuvent être utilisées pour l'achat de publications spéciales, comme des tables de données, des catalogues de fonctions mathématiques, des revues spécialisées et autres renseignements du genre qui ne peuvent être obtenus dans les bibliothèques des universités et qui sont nécessaires à la bonne marche des travaux de recherche subventionnés par le Conseil. Ces publications appartiennent à l'université.

245. On peut se servir des subventions pour payer les frais engagés lors de la préparation des manuscrits, qu'il s'agisse d'articles dans des revues scientifiques ou de livres, et pour payer les frais de publication dans des revues scientifiques. On ne peut toutefois se servir de ces fonds pour payer les frais d'impression qu'entraîne la publication d'un livre.

246. On encourage les bénéficiaires de subventions à publier les résultats de leur recherche subventionnée par le CRSNG dans des journaux canadiens, si possible. Il peut s'agir non seulement des journaux canadiens de recherche publiés par le CNRC, mais aussi d'autres publications scientifiques et techniques canadiennes.

Mention de l'aide du CRSNG

247. Le CRSNG s'attend à ce que les bénéficiaires mentionnent l'aide reçue dans toute publication réalisée grâce à une subvention du Conseil.

Frais de déplacement

248. Les subventions du CRSNG peuvent servir à couvrir les frais de transport, de logement et de repas engagés lors de brefs voyages à l'extérieur de l'université, lorsque ces déplacements sont essentiels à la conduite des travaux de recherche subventionnés. Il peut s'agir des dépenses du bénéficiaire ou de ses adjoints. Ces déplacements incluent les voyages vers les lieux d'expérience (cueillette d'échantillons ou utilisation d'installations de recherche) et pour consulter des collègues ou assister à des conférences, congrès, symposiums, etc. Les frais de déplacement (aller retour) du chercheur vers le lieu de son congé sabbatique et ses frais personnels de séjour au cours de ce congé ne sont pas admissibles. Toutefois, les voyages effectués au cours de ce même congé, vers les lieux d'expérience ou pour assister à des conférences sont admissibles, tel qu'il est précisé ci-dessus.

Tout déplacement lié à des activités de recherche et effectué au cours d'un congé de plus de trois mois n'est normalement pas considéré comme un voyage de courte durée; toutefois, il est parfois possible, dans des circonstances spéciales, d'en assurer le financement à l'aide des subventions du CRSNG:

— To spend research leave outside Canada – candidates must apply through the international programs of NSERC.
— To spend research leave within Canada for 3-6 months – operating, strategic and university-industry grant recipients must apply to NSERC for permission to use research grant funds for transportation expenses only.
— To pursue an extended field trip or to visit a foreign facility in excess of 3 months – permission must be granted by NSERC in writing.

Claims for travel expenses chargeable against NSERC grants must conform to the standard procedures and policies of each grantee's university, and a university has the right not to authorize an expenditure proposed by the grantee if such an expenditure contravenes university policies and/or any NSERC regulations. See paragraph 211 for submission of travel claims.

Grant funds must not be used to reimburse any travel expenditures for members of the grantee's immediate family.

Powered Vehicles

249. Recipients of NSERC grants may purchase a powered vehicle when essential to the research funded through the grant. However, prior university approval is required. By approving the purchase, the university accepts responsibility to provide insurance and any licence required and to register the vehicle in the name of the university. Grantees may also use their grant funds to pay for the long-term lease or short-term rental of such vehicles essential to the research funded through the grant. Grantees who wish to lease a powered vehicle on a long-term basis require the prior authority of the university. This procedure is similar to that required for an outright purchase.

Costs of short-term rentals of vehicles will be recorded on travel claims with other expenses of the field trips, etc.

If powered vehicles purchased through the grant or leased on a long-term basis through the grant are kept at a location other than the university, grantees must be prepared to certify that the vehicle will be used for research purposes only.

Organization of Conferences and Workshops

250. Grant funds must not be used to cover the cost of holding a conference or symposium. Canadian university staff members wishing to obtain funds to support the costs of transportation, meal, and accommodation expenses of guest speakers should apply for a conference grant (see paragraphs 157 to 165). Strategic grant funds may be used for the organization of workshops, provided the request was included in the application. In addition, NSERC is prepared to provide funding for the organization of university-industry workshops (paragraphs 129 to 131) or of other workshops (paragraph 166). Regulations governing these new programs will be stated in the conditions of the award. Council does not have a program of support for attendance at conferences; however, operating grant funds may be used for this purpose (paragraph 248).

— En ce qui touche les congés liés à des activités de recherche à l'extérieur du Canada – les intéressés doivent présenter une demande dans le cadre des programmes internationaux du CRSNG.
— En ce qui touche les congés liés à des activités de recherche au Canada – les bénéficiaires de subventions pour dépenses courantes, de subventions thématiques et du programme conjoint universités-industrie doivent demander au CRSNG la permission d'utiliser leur subvention pour payer leurs frais de déplacement seulement.
— En ce qui touche la prolongation de plus de trois mois d'une visite vers les lieux d'expérience et à une installation à l'étranger, les bénéficiaires doivent en recevoir la permission écrite du CRSNG.

Les frais de déplacement imputables aux subventions du CRSNG doivent être conformes aux procédures et politiques courantes de l'université de chaque bénéficiaire; cette dernière peut refuser les dépenses proposées par le bénéficiaire si elles sont contraire à ses politiques ou aux règlements du CRSNG. Voir l'article 211 pour la présentation des demandes de frais de déplacement.

Les subventions du CRSNG ne doivent pas servir à payer les dépenses de voyage des membres de la famille immédiate du bénéficiaire.

Véhicules motorisés

249. Les bénéficiaires de subventions du CRSNG peuvent acheter un véhicule motorisé lorsque ce dernier est essentiel à la conduite des travaux de recherche subventionnés. Les bénéficiaires doivent cependant obtenir l'approbation de l'université avant d'acheter tout véhicule motorisé. En approuvant l'achat, l'université accepte de fournir les assurances et les permis nécessaires et d'enregistrer le véhicule à son nom. Les bénéficiaires peuvent également utiliser leurs subventions pour payer les frais de location à long terme ou à court terme de tels véhicules lorsqu'ils sont essentiels à la conduite des travaux de recherche subventionnés. Les bénéficiaires qui désirent louer un véhicule motorisé à long terme doivent obtenir l'autorisation préalable de l'université tout comme s'ils désiraient en faire l'achat pur et simple.

Les frais de location à court terme de véhicules seront indiqués sur les demandes de frais de deplacement avec les autres dépenses de voyage vers les lieux d'expérience, etc.

Si les véhicules motorisés achetés ou loués à long terme avec les subventions du CRSNG sont gardés ailleurs qu'à l'université, les bénéficiaires doivent être prêts à certifier que le véhicule servira exclusivement aux fins de la recherche.

Organisation de conférences et colloques

250. Il est interdit de se servir des subventions pour payer les frais d'organisation de conférences. Si un membre du corps enseignant d'une université canadienne désire obtenir des fonds pour payer les frais de déplacement, de repas et de logement de conférenciers invités, il doit demander une subvention pour conférences (voir les articles 157 à 165). On peut se servir des subventions de recherche thématique pour organiser un colloque, à condition d'en avoir fait la demande. De plus, le CRSNG est prêt à subventionner des colloques dans le cadre de son programme conjoint universités-industrie (articles 129 à 131) ou dans d'autres circonstances (article 166). Les règlements s'appliquant à ces nouveaux programmes seront énoncés dans les conditions d'octroi. Le CRSNG n'a pas de programme de subvention pour venir en aide aux chercheurs qui participent à des conférences; les subventions de recherche peuvent cependant être utilisées à cette fin (voir l'article 248).